THURSDAY, APRIL 29, 1880

GEODESY

Geodesy. By Col. A. R. Clarke, C.B., R.E., F.R.S., &c. (Oxford: Clarendon Press, 1880.)

IT is well that there are men brave with the pen as there are others brave with the surgeon's knife or the soldier's bayonet—to whose actions the word temerity can only be applied in the full consciousness that the moving force which impels them is neither vainglory nor ignorance, but a strong sense that providence or fate has placed them in a position where, and when, they, and they only, must obey that call which they feel to be the duty of the moment.

It is not often that this call is so clear to the literary and scientific ear as it has come to be in the province marked broadly on the map of knowledge as GEODESY. And certainly there are few men in England to whose ear we may believe that such a call could have been more directly addressed than to that of the author of this work. It is well, we say, that he has bravely attended to it.

The work to which Col. Clarke has set his hand and seal was one to be dreamt of rather than executed, and we doubt if the worst we could say of the finished deed would not find something more than an echo in the mind of so careful an author. For in truth the task was one of very serious difficulty; and it is in no depreciatory spirit, but quite the reverse, that we have to recognise, by their absence, the chapters—we might almost say the volumes—on various branches of the great subject which we cannot help looking for in a work bearing so broad a title as "Geodesy."

It would be difficult, if not impossible, to treat such a subject as geodesy in a manner calculated to enlighten the present generation as to the present position of the questions which it has raised, without constant reference to the stages through which it has passed. Cousin germane to astronomy, it may claim to be treated with some measure of the respect which has given rise to so many histories of that science; but geodesy can as yet boast no historian. It is a strange fact, and the reason of it is by no means so obvious as the fact is to be regretted. One immediate consequence is that a writer eminently competent to write a treatise on theoretical and practical geodesy is debarred from doing so without the *arrière pensée* of a neglected history—in which department he labours under an obvious pressure of other demands. Thus the first chapter of the work before us reminds one of the explanations which are given to a visitor to some manufactory, who comes out at the end of a series of workshops with a general sense of having had glimpses of interesting work, and a recollection of words having a scarcely understood connection with the processes witnessed; but quite certain, if he paid the same visit a hundred times in the same hurried manner, that he could not understand the manufacture well. There are many points in this first chapter which are either historically inaccurate or so collocated as, while capable perhaps of correct interpretation, to suggest to a mind previously unread more or less erroneous conceptions. It is needless to give instances; for besides that they would but concentrate a needless criticism on points of detail, it is evident that a full account of geodetical operations during two centuries and a half cannot be given in a chapter of thirty-six octavo pages, a very considerable portion of which is taken up with tables, diagrams, mathematical explanations, and numerical examples.

Remarking here, as elsewhere throughout the volume, the author's neglect of the opportunities which are afforded, in the course of a relation of facts, to explain causes of failure, to comment on erroneous and vitiating opinions, as well as to commend those which have borne the test of later experience; in a word, to take upon him the burden of judging wherein lay the foundations of what may now be recognised as sound principle—remarking this abstinence, we are the more pleased to notice and to give some slight additional currency to an exception, which finds expression in at least three places in different parts of the work. It is a condemnation of systems of observation which do not aim at "the 'bugbear' constant error, which is, or should be, the first and last anxiety of every observer." It will be long before a rule, which has all the appearance of courting error rather than truth, will be so generally recognised as to need no "bushing." Meanwhile let it stand forth:—

Presume the existence of a constant effect as the natural concomitant of constant conditions, and if such effect is not itself the object of inquiry, destroy it by opposing conditions, or baffle it by varying them.

At the same time let it be noted that in very many kinds of physical observation, that which is sought depends directly on a *difference* of results, and where this is the case constant errors require to be regarded in a very different light. Geodesy is full of such cases, and one of the most important is to be found in the use of the differential pendulum, where maintenance of condition is the *sine quâ non* of exact result.

The work before us consists of fourteen chapters, each of which is devoted to one particular branch of the subject; and these, on the whole, form a tolerably connected chain of narrative, argument, theory, explanation and illustration, calculation, and discussion of result. Considered as a work on geodesy, it is noteworthy that the last chapter but one (Chapter XIII.) discusses the Figure of the Earth, while the last is devoted, self-contained, to the theory, practice, and results of observation with pendulums. The inference to be drawn from this division is that whatever is to be gathered regarding the earth's form from pendulums is outside of the region of geodesy. So far is this from being our own view, that we would rather have seen this relegated chapter occupying its legitimate historical place as at least the second if not the first in the book. As such it shall be dealt with here.

The mathematics of this part of the subject are very brief and to the point. None of the numerous difficulties are even mentioned here which have at one time or another cropped up, and upon which pages innumerable have been written, printed, and published—to wonderfully little purpose, so far as the practical accuracy of pendulum observations is concerned, but not, perhaps, altogether without influence on collateral physical inquiries. The history of pendulum observations is also very briefly dismissed, with less inaccuracy than commonly falls to its lot. The "invariable" pendulum is of

course described as Kater's, and the ball and wire as Borda's, the opportunity being once more lost of assigning both to their proper epoch, viz., 1735. The method of coincidences is described, but without correcting the common misapprehension of it as a modern improvement, while the introduction of the lens, by means of which Bessel separated the experimental from the clock pendulum by several feet, without impairing but rather facilitating the exact observance of coincidence, is not noticed. In selecting the data with which the recent Russian and Indian observations are to be combined for a new evaluation of the ellipticity, the materials are taken direct from Baily's table, which is open, to say the least, to considerable objection on several grounds. The absolute determinations, both those anterior to Baily's time and those of more recent data, are all tacitly excluded. Granting that this exclusion is not unreasonable, it is impossible not to feel surprise that the existence even of the enormous body of work which is thus passed *sub silentio* is not even mentioned. The recently recognised fact that most, if not all, the modern absolute determinations with the reversion-pendulum are vitiated to a sensible but unknown extent, which can at best be approximately estimated, is noticed, and might have been given as a reason for deferring their use as available data. As it is, we must reckon the estimation in which they are held from their non-appearance here. The same may be said, *mutatis mutandis*, about the older ones, which are without exception impaired, and as yet unavailable on account of the want of the reduction for air-resistance.

We have scarcely approached as yet the subject of this most valuable volume, and already a considerable portion of our available space has been swallowed up. It is in fact as impossible to give a full account of what the author has compressed into its 350 closely-printed octavo pages as it probably seemed to him to give a full and fair account of the enormous amount of work which has been done in all the many countries where surveys have been and are being carried on. Indeed, as of the history so of the present aspect of geodesy, we may say that it is scarcely more than touched on. Whatever is said of the various survey operations in different parts of the world is introduced in the course of description of methods of observing and of reducing, and by way of acknowledgment of sources and of data, or for the sake of illustration. The book does not pretend to give a digest of geodetical operations so much as to declare broadly, and of course in certain respects particularly, what does and what should constitute geodetical practice and theory.

In reviewing, it is above all things necessary to remember that an author has an indefeasible right to frame, arrange, and treat his subject and material as he pleases. But on the other hand the reader has an equal right to be pleased or displeased with the result, and to say in what respects. When, as in the present case, it happens that a very extensive field and a very difficult subject has remained unappropriated by any competent writer for half a century, and is then claimed by a writer who has been before the world as an authority in that connection, his work almost inevitably takes a place which may be said to await it, irrespective of its actual merit. In such a case an undeniable responsibility attaches to the author, and a no less clear onus lies on the reviewer—on the one hand to fall into no errors through carelessness; and on the other to judge fearlessly, rather than add unnecessarily to authority, which already has so much in its favour. If the one is a difficult task, the other is an ungracious one at best.

Passing on now to what is the real body of this work, we find Chapter II. devoted to "Spherical Trigonometry" and Chapter III. to "Least Squares." With regard to these we appeal to what has been said above about the rights of an author and the duty of a reviewer. They are pure mathematics, and we admire them honestly, as deft and elegant condensations of the principal requirements of a geodesist; but not without a sigh, as the truth dawns upon us that this is but the threshold to mathematical labyrinths, of which no plan is furnished, and in which, therefore, we run a fair chance of failing to find the broad paths to which all must keep who would be in accord and who would work together. And in effect in the next chapter we take the desperate plunge into the theory of the figure of the earth, with the method of potentials as our only guide. It is in vain to resist, but, like Christian in the Slough of Despond, we struggle through, with the burden of numberless volumes of National Surveys and Geodetical Operations on our back; and if haply thereafter we meet with a Mr. Worldly Wiseman, surely we will listen to his counsel, and endeavour to find rest without undergoing further like perils.

Towards the close of this chapter we come upon notices of the discussion of twenty years ago as to the possibility of explaining anomalous surface attractions, or the absence of them, by different suppositions as to submontane density. It would be idle to add here a single word to that discussion—not because it has been in any sense closed, so much as because there is room for almost any quantity or kind of fresh assumptions, and because we are unable to see how any decisive result can be reached where all the assumptions are contestable—as for instance that the solid crust is lighter than the plastic nucleus upon which it is supposed to float.

Perhaps the most remarkable result reached in the course of this chapter is the following:—As an example the disturbance of the sea-level is calculated which would be caused by a sphere of matter of surface density one mile in diameter, situated at or near the surface. The calculated amount is found to be only 2 inches; but small as this is, it is further shown that the maximum deflection of the normal to the protuberance thus caused would be 5″ at a distance rather less than 2,000 feet from the summit, or a relative deflection of 10″ between the two points 4,000 feet apart. There can be no manner of doubt that the sea-level surface is not of the same form as would be the case if the mountains were cast into the sea; and if we call the difference "disturbance" of form, then the extent to which the irregularities of form, of whose existence we have abundant proof, is explicable or not explicable by such disturbance is a legitimate part of geodetical study. At the same time, to some it may be a question whether the term geodesy ought not to be understood to consist of the means and methods by which the earth's form and size are discoverable, whatever these may actually be, rather than a general name for all and any studies of the causes or explanations of that form.

Chapters V. and VI. deal with the "Distances, Azimuths, and Triangles on a Spheroid," and with the difficult subject of "Geodetic Lines." By a spheroid is here meant an ellipsoid of revolution of small ellipticity. As, in the sequel, a figure will be sought for which shall, in some respects and for certain limited purposes, serve as a FIGURE OF REFERENCE more closely than any ellipsoid, it may be objected that the term "spheroid," which includes all such *quasi*-spherical forms, should be here qualified by the descriptive adjective "elliptic." And—though it has little to do with these chapters—we may here too remark that the necessity of casting calculations of triangulation into practical forms is the real reason why such non-elliptic spheroids are, and probably must ever remain, unavailable as Figures of Reference on which Trigonometrical Survey calculations can be based. Perhaps all that can be done in that direction is to vary the elliptic spheroid so as to suit the local curvature of special areas of triangulation. But this is anticipating.

The next two chapters are on the "Measurement of Base Lines" and on "Instruments and Observing." Something is said in the earlier about standards. We would gladly have seen a great deal more. Col. Clarke seems often to avoid purposely telling us anything of the origin and meaning of things, and doubtless he would reply to such a stricture that it formed no part of his design. But while bowing to that, one cannot but wish that he had devoted a few pages to giving a concise review of the antecedents of the national standards now in recognised existence. It cannot be that he does not know it all, more thoroughly, perhaps, than any other living person except Sir George Airy. It must be that he is unconscious of the sense of impotent ignorance which so many feel and lament. We know that the Toise, which is now the national standard of Germany, has its prototype in the Toise which Godin copied at the Châtelet, and that the prototype of the Metre bears a definite relation to Godin's—or la Condamine's, as it is often called, because la Condamine procured its recognition as a standard; but what do we know of the Austrian Klafter? and alas, what do we common English folk know of our own yard? Is there not in existence an Act of Parliament defining it in terms of the seconds pendulum? May we affirm that the defining clause was only provisional, and that the whole Act has been repealed? Is it true that our yard is a real entity lying at Westminster; and that there is no other *so* real and actual a standard having a tangible existence? All this we believe—but of what value is such a belief on the part of an unknown reviewer? It is true that Col. Clarke does not leave us wholly in the dark. "The standard yard of this country and its copies," he says, "are bars, an inch square in section, of iron, steel, brass, or copper." There are, we believe, one Standard, five Parliamentary Copies, and some sixty to eighty Secondary Copies—a large number of which are of *bronze*.

In this, as in so many other parts of his subject, Col. Clarke has entirely failed to appreciate the relative worth of information. He is full to overflowing of the knowledge that we want, but there is a part of it which he gives us—not grudgingly we may be sure—but hastily, sparingly, and almost apologetically, as who should say—this we all know; excuse my alluding to it. But in fact all these common things—things of which the want is common to us all—are *not* familiar; we do *not* know them; we find the greatest difficulty in learning about them; and our common knowledge is lamentably defective through the want of them. We hope earnestly that Col. Clarke will recognise this and meet the want in future editions—for that there will be future editions of such a work as this is as certain as that the vast areas being year by year colonised and brought under civilised management will likewise be brought under theodolite and chain in due course. It is with a view to this inevitable extension of surveying operations that we desire so anxiously to see the broader principles of geodesy established on a basis of economy and utility very different from those which have regulated the surveys of older lands.

The chapter on Instruments and Observing is embellished with several excellent representations of theodolites, zenith telescopes, and transit instruments. Though necessarily scarcely more than glancing at the numberless details more or less familiar to the practical surveyor and astronomical observer, it runs through the subject skilfully. We could wish that more were said about the American methods, and we miss at least a notice of the superb alt-azimuth designed by the late Col. Strange—which has never seen service—and his far more successful zenith-sectors, which have both established a reputation second to none. But we are quite aware that nothing less than a series of volumes could do justice to this branch of the subject.

Astronomical observations for the determination of latitude constitute the most important part of the work of a geodetical survey next to those for the determination of distance. These observations consist practically—where a sector is used—in determining the zenith distances of numerous stars. And since these concur to give at any one station but one co-latitude, it follows that they afford a test of the correctness of the N.P. Distances of the stars employed, to each of which is assignable an apparent error, as one of the results of the combination. Where a single station of observation alone is under consideration these apparent errors are rightly enough attributable rather to observation and graduation than to place. But where the same star is thus tested again and again under different latitudes the accordance or approximate constancy of such apparent error can have no rational explanation in any other source than in erroneous N.P.D. This is a practical result which is far from being hypothetical; and we have often thought that neglect to utilise latitude observations in this way with a view to perfect the astronomical place is a waste of material which is well worth attention. The examination here suggested may be readily put to the test of trial by any one who has access to a considerable body of published results of such observations; and if due attention is paid to the identity of the star's place employed at different stations, we can afford to prophesy with confidence that in many cases there will be found sufficient evidence to condemn—and therefore to rectify—the places used.

So much remains to be said in connection with the final chapters that we must abstain from commenting on the next in order—Chapter IX., on the "Calculation of Triangulation," and Chapter X., on "Heights of

Stations," interesting and suggestive as they both are. Few will care to master the former who have not either the misfortune to have a mass of triangulation on hand awaiting reduction, or the luck to have nearly done with one and the curiosity to see whether it is yet open to them to modify their plans. To such as are in the former predicament we may say with the most entire confidence that they will find no safer guide.

In this chapter we remark a short notice of the recent completion of the connection between the Spanish and Algerian triangulations, by a quadrilateral figure whose longer sides, spanning the great inland sea, are 170 miles in length, the longest, we believe, on which luminous signals have been observed. "Thus," remarks Col. Clarke, "a continuous triangulation now extends from Shetland into Africa."

The subject of terrestrial refraction receives ample attention in the chapter on Heights of Stations. We remark as noteworthy that a distinction is found to be necessary between the factor for rays crossing land and those crossing sea. We must here also notice one of the very few errors in the book. On p. 281 "the average amount of refraction" is said to vary from $\frac{1}{12}$th to $\frac{1}{16}$th of the arc between the stations. What is meant is no doubt the average amount of *minimum* refraction.

Our task would now be completed by an impartial review of the remaining two chapters on the "Connection of Geodetic and Astronomical Operations" and on the "Figure of the Earth." Unhappily our attitude in presence of these chapters is a prejudiced, though certainly not a hostile, one. We have regarded the earth, mentally, for so many years as an irregular spheroid, and all ellipsoids or other mathematically simple figures as mere conveniences that we cannot bring to bear upon the exact determination of any particular one of these that intense curiosity which is necessary to sustain one in the search for "the most probable." Under these circumstances it seems both wiser and more courteous not to contend against views whose only demerit is that we do not sympathise with them, but rather to confess dissent and to offer some considerations from a different point of view.

That the sea-level surface of the earth—by many called, for reasons not very clear, the mathematical surface—is an irregular spheroid, no one nowadays will dispute. Neither is it any longer open to question that an elliptic spheroid of revolution, whose compression at the poles is (say) $\frac{1}{300}$th, is *very like* that irregular spheroid. Let us regard these two things as distinct. We may speak of them as the Earth, and the Form. And we may recognise that the latter is provisional, in the sense of being liable to modification if expedient. If, so prepared, the question be propounded, What is the object of geodesy? the answer must surely be on all hands, to determine the Figure of the Earth, by reference to the Form. *By reference to*, not by confusion with, or by means of, still less by *moulding* the Form until it has ceased to be an elliptic spheroid, and has become, if possible, identical in contour with the actual Earth. The Earth remains the Earth, and the Form remains the Form; and Geodesy aims at determining the want of exact conformity between the two. This is the first consideration.

The next is, How can this be done? The answer clearly is, In the first place it cannot be done at all for the *whole* Earth, by any means at present known; but it can be done *partially* in two ways, viz., by the pendulum, wherever there is *terra firma;* and by surveying instruments where this *terra firma* has ample extension; and, in the next place, it can be done by such and such employment of these implements.

Now it seems to us that it is for the proper comprehension of the scope and bearing of this last instruction that light is needed to be thrown by those who are competent. The interest aroused by pendulum operations, for instance, is almost painfully unintelligent, if we compare the simplicity of the fundamental ideas necessary for its comprehension with the obscurity which has throughout characterised the practical development of those ideas. And though there has been no analogous obscurity in the practical development of the other method, it is not the less true that a shadow of another kind has been cast by something like a misdirection. We cannot study the history of this branch of geodesy without recognising that attention has been constantly directed, not upon the Earth, but upon the Form. The whole power of analysis and of calculation has been devoted to perfecting and to designing a "more probable" form, and to showing that on certain conditions (which the earth, if it were only moderately amenable to reason, would recognise the justice of) the form so designed comes very near indeed to what the earth *should be.* What is the inevitable verdict which results from a charge of this description? WE FIND THAT THE MEAN FIGURE OF THE EARTH IS A SPHEROID WHOSE AXES ARE IN THE PROPORTION OF ABOUT 292 : 293. The finding is brief enough, truly; but is it in accordance with the evidence? Surely, yes! for that word "mean" will cover whatever we like to put under it. But it is none the less an unsatisfactory verdict. Let it be remembered that the accuracy insisted on in trigonometrical surveying operations and reductions is far greater than is required for fiscal, commercial, or what are commonly called practical purposes. The object of this exceeding accuracy is geodetical. Thus, for instance, no one would dream of surveying a small isolated island with such accuracy. A great part of the cost of a continental survey, therefore, has to be reckoned as sunk for the sake of ultimately learning more about the exact shape of the earth than we could at present see any direct utility in. But as yet we have got very little further than a positive certainty that that shape is irregular. As surveys extend and get connected with each other, some better return for the labour expended is demanded. The geodesist begins to think of phrenology, and to speculate whether he can yet venture to map out the earth's bumps as he has already mapped out land and sea. He learns to regard what were looked on as local disturbances of the plumb-line as the means to that end. He sees in them no longer mere *errors*, to be herded by the theory of probabilities, but distinct indications of that which he has to work out.

And if, meanwhile, despairing of obtaining, by the slow and grievously costly processes of land measurement, data enough for such a purpose, his eyes should be opened to the practical facility of obtaining such, *ad libitum*, by means of the pendulum; he may well be pardoned if he turns somewhat impatiently away from the

former, and demands that reason shall be shown for not diverting to the service of the latter at least a large share of attention.

Remembering that measurement of arcs and elaborate study of the earth's irregularities by the plumb-line never can extend much beyond the continents and larger islands, and never will extend far in advance of civilisation; while pendulums can, and assuredly will some day, form part of the equipment of every scientific exploring party, it does seem passing strange that we should still be discussing the ratio of the axes of a convenient figure of reference (p. 287) as a more important question than the actual nonconformity of the earth to *some* approximate figure of known form.

What we would fain see, as the *geodetical* fruit of first-class surveys—if not done, then attempted; and if not even attempted, then at least inculcated as to be done or attempted—is, a comparison of the earth's surface, as actually measured, with some provisionally adopted form, showing where possible the relative position of the actual zenith, as determined by astronomical observations, with respect to the formal zenith. And then, a discussion of such results, showing, either a traceable continuity of the irregularities of the actual surface, if such exists; or evidence of discontinuity such as to justify a presumption that the irregularities are too small in area to be susceptible of study without closer distribution of stations.

Thus we might haply arrive at one of two conclusions—that large irregularities exist which may be mapped, or that the irregularities are such as to demand special investigation by a recurrence to observation in selected localities.

If to this suggestion it is objected that the thing has been done—and we know that the irregularity in the neighbourhood of Moscow has been investigated in some such way—we reply that, even so, a short paragraph noticing the fact (p. 288) is but a meagre presentation of what seems to us one of the principal results of methodic geodesy.

And now that we have done and have to lay down the pen, it is with a feeling of regret and a sense of incompleteness. The book deserves so much better than we have said of it. We have identified ourselves too entirely with the student looking for special instruction and too little with the author giving the best he had, and have quarrelled with him because it was too good for our needs. Once more be it said that the subject is too large for a single work—it needs a series. It is but the absence of a few apologetic words that has given this sense of a subject approached at many points only as it seems to be immediately quitted, in favour of others which have more attraction to the author. Now that he has dwelt on them, may he resume his task, and enlarge where we have shown the need.

J. HERSCHEL

OUR BOOK SHELF

The Fauna of Scotland, with Special Reference to Clydesdale and the Western District—Mammalia. By E. R. Alston, F.L.S. (Glasgow: The Natural History Society of Glasgow.)

THE Natural History Society of Glasgow, having resolved to publish a catalogue of the fauna of the western district of Scotland, have secured the co-operation of Messrs. Alston, Young, Cameron, Robertson, Binnie, and Lumsden. Already one part of the catalogue of the Crustacea and one part of the catalogue of the Hymenoptera have been issued, and these have now been followed by the present part, treating of the Mammalia. The Society is doing a good work, and will be fortunate if all the parts as published come up to the standard of the one now before us. In the nomenclature of the Mammals, of which fifty-one are recorded, the author endeavours to reconcile the spirit and the letter of our British Association rules. Without entering into any details of description or economy, he has carefully worked out the geographical distribution of each species. A very interesting list is given of extinct and recent Scottish Mammals, arranged in the probable order of their arrival from the southward.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Auroral Response in America

WHEN the full burst of auroral displays is upon us, and one brilliant demonstration treads close on the heels of another, there may be some trouble in ascertaining which corresponds to which on opposite sides of the earth. But the opening of the new cycle-season by the arc which I described in your pages on March 17, has proved so isolated a phenomenon in time, that it cannot be confounded with any other either before or since. And while your subsequent notice of the disturbance of the magnets at the Royal Observatory, Greenwich, on the same night, proved that the aurora seen in Edinburgh was an earth-ball phenomenon, and not a mere local atmospheric glimmer, the following letter, which has just reached me from Canada, shows a remarkable correspondence to have prevailed there.

The letter, written to me by Lieut.-Col. G. E. Bulger, late 10th (North Lincoln) Regiment, from Montreal on April 10, is word for word simply thus:—

"I have noticed your account (NATURE, vol. xxi. p. 492) of the aurora seen in Edinburgh on the 17th ult.; and it has occurred to me that it might interest you to hear of a similar display which I observed at this place on the same date. Your description would apply very well to the one witnessed here, excepting that the arch was higher in the sky, and its centre about N.E. The darkness below the light was very marked, although the moon was shining brightly at the time. Auroras have been singularly rare here this year, and that referred to is the only one I have seen or heard of since my arrival in August last. The weather on March 17 was bright and fine, with detached clouds, and a light N.W. breeze. The barometer (aneroid) at 9 p.m. was 30·36, therm. 14°·7."

Thus far Col. Bulger; and now we have only to wait the arrival of Australian meteorological reports to ascertain whether south responded to north, as well as west to east, on the occasion of that remarkably isolated auroral display, abundantly observable, yet observed by so very few persons, in this country on March 17 last.

PIAZZI SMYTH

15, Royal Terrace, Edinburgh, April 26

The Antiquity of Oceanic Basins

I AM much obliged to my friend Prof. Alex. Agassiz for reminding me that his distinguished father, when reporting on the deep-sea dredgings carried on by the United States Coast Survey in 1866-68, explicitly endorsed the views previously put forth by Prof. Dana (to whom, however, he made no reference) as to the geological antiquity of the American Continent and the probable determination of the general outlines of the present Continental elevations and Oceanic depressions at the very beginning of the formation of inequalities upon the Earth's surface. . .

Prof. Alex. Agassiz must have strangely misread that paragraph in my lecture in which I refer to the two deepest soundings of the *Tuscarora* if he supposes that I intended to cast any doubt upon their trustworthiness as indicating "depths considerably exceeding 4,000 fathoms." In the Official Report, now before me, these two soundings are thus recorded:—

"No. 15: 4,643 fathoms. No specimen (of bottom). Wire broke. Bottom not reached.

"No. 33: 4,655 fathoms. No specimen. Wire broke."

As there is no mention in the second case of the wire having broken in reeling-in (which is stated in several other cases), and as the length of wire run out corresponded almost exactly with that run out in the first, it was not unnatural that I should suppose that the wire broke by its own weight without reaching bottom. But I expressly cited these two soundings, incomplete though they were (no specimen of bottom having been brought up), as evidence in support of my case that those "gigantic pit-holes," in which extraordinary depths have been encountered, occur in regions of great Volcanic activity.

56, Regent's Park Road, N.W., April 27 — WILLIAM B. CARPENTER

Seeing by Electricity

WITH respect to the letter of Messrs. Ayrton and Perry (NATURE, vol. xxi. p. 589), in which they propose to utilise for this purpose Dr. Kerr's discovery of the rotation of the plane of polarisation of light reflected from the pole of a magnet, will you allow me to give you some details of a repetition of Dr. Kerr's experiment which I made a year or two ago.

I used an electromagnet consisting of an iron bar 2 feet 4 inches long and 2¼ inches diameter, surrounded by 70 lbs. of wire, and excited by ten Grove cells.

The total *double* rotation produced, not by slightly altering the resistance, but by reversing the current, was never more than 26′ (twenty-six minutes of arc).

To see this at all with a very delicate Jellett analyser, it was necessary for the observer to increase the sensitiveness of his eye by sitting in total darkness for some ten minutes before each observation.

Your readers can judge what chance of obtaining visible changes of illumination there would be with "little" magnets and mere variations in a current not powerful enough to fuse a selenium resistance. — J. E. H. GORDON

32, Elvaston Place, Queen's Gate, S.W., April 22

Ophiolepis mirabilis

THE statement concerning Prof. Martin Duncan's *Ophiolepis mirabilis* contained in the review of Prof. Lyman's account of the *Challenger* Ophiurans was not intended to represent an expression of opinion of the Reviewer upon the matter, but simply the conclusions of Prof. Lyman as expressed in the memoir under review. The matter was not cited as a question of mistake, but of difference of opinion between two experts. Prof. Lyman enters, in the memoir referred to, at some length into his reasons for considering Prof. Duncan's species, as described, to be a true Ophiopholis. This latter genus Prof. Lyman thinks quite remote from Ophiolepis, in spite of the evidence adduced by Prof. Duncan. I am sorry that I did not make it clear that I was citing Prof. Lyman's opinion and not expressing any judgment of my own. — THE REVIEWER IN QUESTION

The Ômori Shell-Heaps

DESIRING as much as possible to save space and avoid rhetoric, I shall be content to reply to the pith of Prof. Morse's amusing diatribe contained in NATURE, vol. xxi. p. 501, principally by citing extracts from a recent paper on Prehistoric Remains in Japan, read by Prof. Milne before the Asiatic Society of Japan, and printed, together with a report of the discussion it gave rise to, in their *Transactions*, published in February last, which I received about a fortnight ago.

The main object of my note in NATURE, vol. xxi. p. 350, was to show that the antiquity claimed by Prof. Morse for the Ômori mounds was not warranted by the facts. In this view I am supported by Prof. Milne, Dr. Faulds, and Mr. Aston, whose united authority I venture to prefer to that of the Salem zoologist.

Prof. Milne examined a number of shell-mounds in various parts of Japan, both in Yezo, where the Aino race still flourishes, and in the main island, including the Ômori heaps, but he does not mention having met with any human remains in any of them. Adverting to Prof. Morse's conclusions from his examination of the Ômori shells, which may be briefly presented thus:—

That changes have taken place in the relative abundance, size, and proportions of certain species and in the extinction of certain species,

Prof. Milne quotes from the Memoir: "The modification in the relative size, &c., is profound, and seems to indicate" either a shorter period of species-variation than is commonly admitted, "or else that the deposits presenting these peculiarities have a much higher antiquity than had before been accorded them." Prof. Milne (but then he is merely a "Briton in Japan," and *quâ* such disposed, doubtless, in the eyes of Prof. Morse, to sneer at everything Japanese, shell-mounds included) is inclined to think these modifications "in great measure due to the great changes which have been taking place in Yedo Bay *during recent times*." The italics are Prof. Milne's. ". . . The bay is rapidly silting up. . . . during the last 800 years large cities have sprung up round its shores, all of which have added something to destroy the purity of its shallower waters. All these causes combined are and have been making changes in physical conditions, and with them we should naturally expect a rapid change in the faunæ which are dependent on them." Further on a map is given showing the ancient coast lines at and near Yedo, and proving the magnitude and rapidity of the various successive encroachments of the shores upon the waters of the bay.

Again, "The conclusion to which I am led with regard to the shell-heaps is that they are of Aino origin . . . the positions which these shell-heaps occupy are on spots which we know . . . were once tenanted by Ainos, and even down to the end of the twelfth century Ainos were living in Nipon." By Nipon is meant, I presume, the main island. I may add that I have often heard from Japanese of Aino colonies still existing in the north-eastern districts of the main island, but not distinguishable by language, or customs, or otherwise than physically from their Japanese neighbours. The average advancement of the land at and near Yedo, Prof. Milne states as varying from 38 feet to 2 feet per annum, which would account for the present distance of the Ômori heap from the shore being attained in from something under 100 to something over 1,000 years. Mr. Aston, in the course of the discussion which followed the reading of Prof. Milne's paper—I quote from the report in the *Transactions*—"was glad to observe a tendency to diminish the antiquity which had been earlier assigned to these remains (from Ômori) by some of the writers on the subject. Civilisation in Japan is a product of much more recent growth than in Europe, and we do not require to go so far back in order to meet with tokens of a primitive degree of advancement." Mr. Aston then showed that in the middle of the eighth century a large portion of the main island was exclusively Aino. Dr. Faulds assigned "600 years as the probable antiquity of the Ômori heap," and Prof. Milne in reply said that the rise of land variously evidenced round Yedo Bay, "taken in conjunction with the vast deposits of silt which are brought down by the various large rivers which flow into the bay, would make the changes in coast-line exceedingly rapid."

With regard to the pottery of the Ômori heaps, Prof. Milne says:—"The designs are in very many instances similar to the designs which are carved by the Ainos of the present day." On this point Dr. Faulds's testimony is more emphatic. "The 'mat' impressions figured by Prof. Morse in Plate V. Fig. 1, are to be found repeated in the most recent pottery;" the types of pottery in the shell-heaps did not seem "to be separated by any one well-marked character from contemporary pottery of a low grade. The shell-heaps scattered along the old and recent coasts of Yedo Bay presented in their fragments of pottery a series of modifications leading up to recent times, and some of the heaps may be seen in actual process of accumulation." Further, Mr. Ninagawa of the Tokio Museum, the principal authority on the subject of Japanese pottery, decides that the "remains . . . cannot be older than 1,000 years." Dr. Faulds showed some coarse pottery of the day not dissimilar to that of the shell-heaps, and was not even prepared "to accept finally the belief that the Ainos were the founders of these heaps."

From personal investigation of many remains of shell-heaps on the coast-line and inland between Yedo and Yokosuka, I can corroborate Dr. Faulds's statement. I do, however, believe that the heaps at Ômori were the handiwork of Ainos, very

possibly after they had come into contact with the Japanese, though some of the other heaps I have seen were undoubtedly raised by the Japanese themselves; in a few cases they appeared of quite recent accumulation.

Great stress is laid by Prof. Morse upon the platycnemic tibiæ found in the heap. But platycnemic tibiæ, as Prof. Milne well points out, are characteristic of the Aino race, and, I believe, though I cannot put my hand upon my authority, of other low-type existing peoples.

The "extraordinary blunder" the usual "Japanese gentleman" has with patriotic promptness reproved me for making I cannot notice, for I have not hitherto seen any statement or correction of it. But in saying that the eastern portion of the main island was probably peopled by an Aino race up to the fourteenth or fifteenth centuries, and in asserting that Yedo was not founded until the close of the sixteenth century, I was not strictly accurate. The most valuable information to be extracted from native works is to be got at by reading between the lines, and, following this system, I have for my own part arrived at the conclusion that, up to the thirteenth or fourteenth centuries at all events, the country east of the Rokugo River was peopled by a mixed Aino and Japanese race, whom I believe to have been the builders of the mounds. Ôta Dôkuwan erected a stronghold upon the site of the present castle of Yedo about the middle of the fifteenth century, but the *Yedo Meisho* (cited by Mr. McClatchie, in his paper on the Castle of Yedo, *Tr. Asiat. Soc.* Japan, vol. vi. part 1) tells us that up to the end of the sixteenth century it "was merely a small fortification" overlooking, doubtless, an inconsiderable town consisting of a mere aggregation of villages. Iyeyasu made it his capital about 1590, and gave to the city the apt name of Yedo, or Door of the Rivers. What Prof. Morse means by charging me and "so many of" my "countrymen" with "the wilful blunder of calling the principal city of the empire by its wrong name" I cannot imagine. Does he find in the practice some covert "sneer" at things Japanese on the part of the "ordinary Briton"? Then is the "extraordinary American," who sheds upon Salem its due supply of zoological light, guilty of the same offence, for in his memoir he talks of "the bay of Yedo," "maps of Yedo," &c. The fact is the expression "Tôkiô," invented by the successful party after the Revolution of 1868, would have been unrecognisable by many readers of NATURE. Again, Yedo is a Japanese word, and *is* the name of the city; Tôkiô is a mispronounced Chinese compound, meaning "eastern capital," and is, properly, a mere official designation. So under the Shôguns Yedo was often called by various Chinese styles, but never lost its name of Yedo.

My belief that the mounds were swept away was founded upon a statement to that effect I saw in a Japanese newspaper since leaving Japan, after many years continuous residence, in January, 1879. But whether my belief was right or wrong, I fail to understand how its expression could raise such ire in Salem. I sincerely trust that my inadvertence in not recognising the last plate of the memoir as a copper one will be forgiven.

Lastly, Prof. Morse complains of my review, as he terms my brief note on his memoir, being written in some "spirit" which he does not "now heed." This is deplorable, for it was written simply in the "spirit" of truth.

The question of cannibalism is discussed in Prof. Milne's paper in a most interesting manner. I would gladly give a *résumé* of his remarks on this portion of the subject, and answer some points I have left unnoticed both in the memoir and Prof. Morse's letter, but I fear that I have already trespassed terribly upon your space.

F. V. DICKINS

Arts Club, April, 1880

The Destruction of Insect Pests by Application of Yeast

THE article on the destruction of insect pests, &c., in NATURE, vol. xxi. p. 447, by Mr. E. R. Lankester, contains statements upon which I beg to make some remarks:—

"Prof. Hagen has called attention to the old practice of destroying greenhouse pests by the application of yeast."

It is very interesting to me to hear that this is an old practice. I had never known it, and would be glad to receive any notice where it is published. In the many letters which I received since the publication of my pamphlet, nobody has mentioned that the use of yeast against greenhouse pests is a well-known remedy. Mr. Hovey, for fifty years the editor of the *Magazine of Horticulture*, assured me that he never heard of it. After it was suggested by me last year, the application of yeast has proved to be successful against Aphides.

"He imagines that the yeast-fungus enters the body of the insect on which it is sprinkled, and there produces a growth which is fatal to the insect-life."

For the experiment with potato-bugs, published in my paper, 100 beetles collected the same day and in the same place were divided into two parcels, and both kept in the same room. One parcel was sprinkled on three or four successive days, and most of those beetles died on the eighth day, the last one on the twelfth day. Of the other parcel all but three were alive and bright six weeks later, and more than 50 per cent. lived through the whole winter. I found in the dead ones, which had been sprinkled with diluted yeast, in the large sinus of the wings, spores of a fungus in quantity. The spores resembled those figured by Dr. M. Reess,[1] Plate I., Fig. 15, *ed*, and were so numerous and so distinct that I could not have been deceived, the more as I am familiar with the anatomy of insects and with the blood-fluid and its contents. Not having studied, myself, fungi, I can only state that, after the beetles having died in a manner which showed manifestly an infection, I discovered cells in the blood-fluid which certainly are not to be found in the blood-fluid of unpoisoned insects, and which are similar to the figured ones.

It is a fact corroborated lately by Mr. A. Giard that a few spores of a poisonous fungus in a comparatively large quantity of water are sufficient to be propagated in caterpillars, which are sprinkled with such water. There is no doubt that a mash-tub into which a diseased insect has once fallen will keep up a sufficient supply. Nevertheless when such spores are so common in mash that Dr. Bail, in using brewers' yeast, succeeded in numerous experiments, and that here the use of dry top-yeast, as well as the use of compressed bottom-yeast, gave the same successful results, I believe that it is of no particular avail to cultivate artificially Isaria spores in beer-mash. The recommendation to use simply yeast would be sufficient, and so it was given by myself: "The general result of the most accurate investigations of the beer-yeast fungus is entirely opposed to the notion *that it can enter an insect's body* and produce a disease." I am perfectly unable to find the publications alluded to, which, of course, would settle the question at once. Nothing in the size and the form of the spores would prevent them from entering the body.

The ingenious suggestion of a collection and cultivation of an insect's disease-producing fungus was made and published in 1874 by Dr. John L. Leconte, from Philadelphia.

Cambridge, Mass. H. A. HAGEN

Recall of Sights and Tastes

I THINK the following two facts, from my own personal experience, may be of some interest to Mr. Francis Galton.

1. In 1875 I was appointed by the Venezuelan Government to organise the library of the University in this city. The collection contained then about 8,000 different works, which I arranged and numbered on their backs, having no assistant but a servant for the rough part of the labour. Since that time I have been head librarian, it being my duty to be at the library on all mornings, Sundays excepted. It is natural that I should therefore know the place of every book on the shelves; but in the case of the more important works, as soon as the title is mentioned I am able to recall to my mind the exact appearance of the books, with their corresponding numbers, the lettering being however much less distinct. It is no case of memory; for I cannot say what book is to be found under a certain number; I must first have the image of the book, and afterwards I read its number, as if it were actually before my eyes. A considerable part of later additions to our library was numbered by the assistant librarian, as amongst these books there are but few which I can recall to my mind in the manner described.

2. In Mérida (a western state of Venezuela) the people use a substance called *chimó* (pronounce *cheemó*). It is made with the juice of tobacco, inspissated to the consistency of syrup, and mixed with powdered *urao*, or sesquicarbonate of soda, from a small lagoon near the village of Lagunilla, not far from the town of Mérida. The *chimó* is black, and kept in small boxes made from the horns of cattle. When used a small quantity is put into the mouth outside the gums, where it is slowly dissolved by the saliva, and then swallowed down. Being myself pretty well accustomed to smoking cigars, I once felt desirous to try

[1] "Botanische Untersuchungen über die Alcoholgährungspilze," von Dr Max Reess. (Leipzig, 1870.)

this singular mixture, but with so bad a result that from that time (nearly four years ago) the mere recollection of the experiment produces again not only the indescribably nasty taste of the *chimó*, but sometimes even the vomiting, which was the end of my first and only attempt to use this luxury of the *Meridenos*. And for this very same reason I hasten to put an end to this note. A. ERNST

Caracas, March 18

Anchor-Ice

THE formation of anchor-ice has attracted a good deal of attention in Upper Canada, although I am not aware of any efforts having been made to describe theoretically the cause of its formation. Prof. H. Y. Hind, some time of Toronto, alludes to it in a paper read before the Geological Society (*Proc. Geol. Soc.*, xxi. p. 128), and I believe the late Sir Wm. Logan, director of the Canadian Geological Survey, also brought the matter before the same Society, though I cannot trace up the paper, and Mr. Keefer, C.E., of Ottawa, read a paper on this subject before the Canadian Institute (*Canadian Journal* (new series), vii., p 173, 1862).

The conditions under which anchor-ice forms appear to be those mentioned by Dr. Rae, as far as my own observation goes, and Prof. Hind remarks, in the paper alluded to, that it is not uncommon for the seal-nets off the Labrador coasts to be frozen, in water as deep as 60 feet, and that the anchors of these nets frequently bring up masses of frozen sand. The most interesting question in connection with this subject seems to me to be, Does the ice form, from the precipitation of the very minute ice-particles, in passing over the rapids, or does the intense cold of the ground favour the formation of *rasee*, as it is locally called, independently of the floating ice-particles passing over the *stones?* I have never known it to form on clay or alluvial bottoms.

There is another form of anchor-ice to be found in the great northern lakes, which floats in large sheets at a considerable depth under the surface of the water. During the construction of a large breakwater on the Georgian Bay I had a great deal of trouble from large floes of this ice, which seemed to be floating in layers at various depths in water 14 feet deep. The local opinion was that this ice was formed on the extensive rocky shoals which abound on that coast, and more particularly in the neighbourhood of the work on which I was engaged, and that the floes became detached by storms and the hammering of the surface-ice upon them. Whatever may have been the cause of their formation, they were very destructive in their force upon the timber caissons which were being sunk.

Edinburgh, April 22 ALAN MACDOUGALL

THE SONGS OF BIRDS.—D. W., of Freiburg im Breisgau, writes that Mr. C. C. Starling (NATURE, vol. xxi. p. 590) will find an elaborate paper, "Ueber Vögelstimmen, &c." (especially on their musical properties, with many notes), by Prof. Oppel, of Frankfurt-on-Main, in the monthly journal *Der zoologische Garten*, February, 1871 (vol. xii. No. 2), published by the Zoologische Gesellschaft of that place.

GEOLOGICAL SURVEY OF THE UNITED STATES

IT is now about a year since the Congress of the United States took seriously in hand the question of the national scientific surveys and made a complete reorganisation of them, consolidating the geological work into one general Geological Survey of the United States, under Mr. Clarence King as director. Some time had necessarily to elapse before much fruit could be seen from the new tree. It was especially needful in the first place to justify the large expenditure of money required for the organisation, by showing that not merely pure science, but the industrial and commercial interests of the country were materially aided by the Survey. Consequently while ordinary geological surveying has not been neglected, the chief strength of the staff has been expended upon economic geology, and more especially on the deposits of iron, lead, silver, and gold. Some of the great mining districts of the West have been very carefully explored, and the results will be embodied in the Annual Report. It is understood that Mr. King's general plan is to arrange his forces in two divisions, one charged with the investigation of the economic geology, the other with general geology or the geological map. The second division will no doubt be mainly engaged in the Western States and Territories, which will be parcelled out into large districts each under a special officer. Thus there will probably be a corps placed on the Pacific slope, another on the Great Basin, a third on the Plateau country, and a fourth in the eastern mountain ranges, or Rocky Mountains proper. But besides this general distribution of the staff there is an intention, we believe, to devote attention to special problems further east, and, in a most liberal and thoroughly scientific spirit, to employ for their study the best geologists who can be found in these regions to undertake the duty.

Rumours of this last branch of Mr. King's scheme have been rife for some months past in the Eastern States; and, like most rumours, they have doubtless exaggerated the true state of the case. In a recent number of NATURE (vol. xxi. p. 197) attention was directed to his alleged proposal to extend the operations of his staff not only over the Western Territories and other parts of the public domain, but also over the Eastern and long-settled States. In spite of the serious and emphatic protest made by Prof. Dana against this proposal, we spoke of the proposal itself as a kind of joke, meant chiefly to flutter the geologists of the East, but with no serious thought of claiming in any way jurisdiction in the Eastern States. It appears, however, that the Director, in answer to official inquiries, has written a letter, which has been laid before the Senate by the Chairman of the Committee on Appropriations, to be printed in connection with a joint resolution authorising the extension of the Survey. In this letter he states that the Survey as at present constituted, being understood to be limited in its application to the national domain or public lands, cannot possibly present a general exposition of the mineral resources of the whole country, and that in spite of its labours for their enlightenment, "the people of the United States must remain ignorant of the extent, nature, and broad practical relations of their mineral possessions." He therefore insists on receiving from Congress authority "to work over the whole United States and to study its whole economical geology," summing up his arguments by declaring that "briefly and finally, in my belief, the question of the passage or defeat of the resolution under consideration is the question whether it is or is not desirable and needful for the people of the United States to thoroughly know the nature, extent, and uses of their mineral possessions."

In Mr. King's view the work of his Survey should be to collect statistics of the annual output of minerals, to publish a yearly volume giving full information of the progress of the mineral industries, "to actually and directly aid in their development," "to promote the wise and guarded influx of foreign capital," and generally to study the mineral wealth of the country in its extent, in the relations of one kind of deposit to another, and in the relations of all the deposits to industrial and commercial progress.

Mr. King no doubt knows intimately the temper of Congress, and understands precisely the tactics to be pursued to get from that body an appropriation of $340,000. He is aware that he will be much more likely to gain his end by showing that he can augment the number of dollars in the national exchequer than by trying to persuade the legislature to believe in the importance of discovering the southern limits of the Northern Drift. He must be allowed to be a better judge of how to get a large vote from Congress than any quiet onlooker here can pretend to be. Yet even from his own point of view there are some aspects of his letter to which, with all deference to his well-known tact and

great experience, objection may be taken. There surely was no necessity for the introduction of such statements as that the value of a mineral in one State might be dependent on a single chemical fact or deposit in a remote State; that a New Jersey iron-founder may have to mix ore from Virginia with ore from Michigan, and procure his fuel from Pennsylvania and his fire-brick from Connecticut; and that gold-seekers in Georgia would lack a personal knowledge of California. Does Mr. King suppose that the mining industry of his country will stand still until it is instructed by the Geological Survey? The mining owners and speculators are quite alive to everything likely to be for their interest, and may be safely trusted to look after themselves. "The iron-corps of Wisconsin," he says, "could never safely judge of a Pennsylvania ore, which was required to be mixed with the Wisconsin product, unless the two were investigated together and their direct relations studied." But the Wisconsin corps could perfectly decide as to the amount of metal in the ore and the extent and workability of the deposit. The geological relations are unquestionably most interesting and important, but ignorance of them is happily not fatal to a very thriving industry.

The Director, it seems to us, does himself and his associates injustice in taking far too low a stand on which to urge the importance of a truly national Survey. In dealing with a popular assembly it is of course necessary to show that a service for which large grants are demanded has a real practical utility. But it is possible to carry this principle too far, and thereby to defeat its object. An acute Congressman might rise and object to such large appropriations being granted for what appeared to be mainly a work of statistics. "Mr. King's letter," he might argue, "puts great stress on the collection of accurate statistics of our mineral wealth. But we don't need a corps of trained geologists with good salaries to scour the country, finding out how many tons of coal are raised here and how many ounces of gold have been crushed there. I can undertake to do all this at a fiftieth part of the cost. All I ask is a couple of clerks and a free postage allowance. I would send a printed form to every mine-owner and district agent in the country, with columns in which to enter all the industrial particulars needed. And I would guarantee to lay before Congress as full and accurate a statement of our mineral output as Mr. King could do with his corps of geologists. Of course if Mr. King is going to make a scientific survey that is another matter. Let him set his corps to work on it, getting the most highly trained men he can find for the purpose. But it would be a waste of brain-power as well as of public money to employ scientific men to do mere clerks' work. Let us have under the Department of the Interior an office for mineral statistics, and leave the Geological Survey free to do proper geological investigation."

There is another part of Mr. King's letter which to an impartial spectator of the discussion cannot but appear ominous of possible evil. He states that it will be among the duties of his Survey "to actually and directly aid in the development of the mineral industry, and promote the wise and guarded influx of foreign capital." Our irrepressible Congressman would no doubt exhaust his eloquence on this topic. "What!" he might exclaim, "are the geologists of the Survey not only to collect statistics, but to be a kind of superior share-brokers and mining speculators? I wonder how much time they are likely to find for really geological work. I hope that they are men far above the love of filthy lucre, anxious only for their country's good, incapable of taking a fee, utterly unbribable. Certainly their virtue will be put to the proof. A mining company stamped with the approval of the Geological Survey will no doubt be more easily floated into the market. On the other hand, a company whose claim is condemned as worthless by the official authorities need not expect its shares to rise in value. Such approval or condemnation will no doubt be naturally regarded by mining men as a purchasable commodity. Even should every member of the Survey keep himself wholly apart from transactions of this kind, it is a misfortune that he should ever be exposed to temptation and to the suspicion which the public knowledge of that temptation so often and so unjustly arouses." No one who knows anything of Mr. King and his associates will for a moment entertain such suspicions, but may resent the mere mention of them. Nevertheless the Survey would do wisely to avoid having anything to do with capital either foreign or domestic. It cannot too jealously guard its scientific reputation. So long as its labours are strictly geological it will be regarded with respect as an impartial tribunal. The moment it begins to meddle with the monetary aspects of mining it will occupy a lower place in public estimation. What is more, it will make enemies. Disappointed speculators will find ample opportunity of revenge; and Mr. King may have a yearly struggle to get his appropriation.

With the most cordial interest in the welfare of the newly-organised Survey and every desire to see it enter upon a long, brilliant, and useful career, we would earnestly urge upon the authorities the desirability, nay, even the necessity, of concentrating as large a part of the force as possible upon the unsurveyed and only partially explored western regions. While this great work is in progress Mr. King will doubtless find ample opportunity of keeping before Congress and the public the industrial aspects of the Survey, and of showing that, even in a pecuniary point of view, the annual expenditure of money is well bestowed. He may be able to make use of the active geological talent of the Eastern States to aid him in collating geological sections and in working out special problems of general interest and importance. In the midst of these labours we do most sincerely trust he will see his way towards collecting material for a first general geological map of the United States. Nothing worthy of the name yet exists, and though many years must elapse before a detailed and accurate map can be issued, a very great boon would meanwhile be conferred, not only on geologists, but on the general public, by the preparation of a map (such as that published by the Lands Office) giving in condensed form the general results of geological investigation all over the Republic.

ARCH. GEIKIE

STONE ARROW HEADS

MANY surmises have been offered as to how our prehistoric ancestors could have manufactured stone arrow heads before the uses of bronze or iron were known. Sir John Lubbock, Mr. John Evans, and other writers have suggested that the observations of travellers as to the mode pursued by savage nations in similar work might possibly lead to some correct conclusions. Acting on this hint Mr. B. B. Redding had published an account of the manufacture as practised by the Cloud River Indians. Prior to the close of the Modoc war the Wintoons or Cloud River Indians were without firearms. Up to that time the few settlers who resided about the base of Mount Shasta made it a rule to permit no Wintoon to carry a gun. As there are no agricultural lands and no mines on the Cloud River the Wintoons were left in almost undisputed possession of their prolific hunting-grounds and to the inexhaustible supplies of salmon and trout with which that river abounds. They had but little contact with the Americans until a station was established on their river by the United States Government for the taking of salmon eggs for distribution. Even to this day very few of them have guns, and their principal reliance in the chase is upon their primitive but powerful bow and arrows with stone heads. The stone arrow head maker is still a man of great importance in the tribe, and one of

the best of these undertook to make, in Mr. Redding's presence, a stone arrow head, using only such tools and implements for this purpose as were in use by the Indians before their contact with the white man. Promptly at the time appointed the old man, Consolulu, appeared, grey-haired, and though between sixty-eight and seventy-two he was still erect and vigorous. He brought, tied upon a deer's skin, a piece of obsidian weighing about a pound, a fragment of a deer's horn, split from a prong lengthwise, about four inches in length and half an inch in diameter and ground off squarely at the ends; this left each end a semicircle, besides two deer prongs with the points ground down into the shape of a square sharp-pointed file, one of these being much smaller than the other. He had also with him some pieces of iron wire tied to wooden handles and ground into the same shapes. These, he said, he used nowadays in preference to the deer prongs, simply because they did not require such constant sharpening. Holding the piece of obsidian in the hollow of his left hand, he placed between the first and second fingers of the same hand the split piece of deer's horn first described, the straight edge of the split horn resting against one-fourth of an inch of the edge of the obsidian, this being about the thickness of the flake he desired to split off, then with a small round water-worn stone which he had picked up, and which weighed perhaps a pound, he with his right hand struck the other end of the split deer's horn a sharp blow. The first attempt resulted in failure; a flake was split off, but it was at the same time shattered to fragments. The next blow was successful, a perfect flake was obtained, and a third was equally so. Now squatting on the ground, sitting on his left foot, his right leg extended in tailor-like fashion, he placed in the palm of his left hand a piece of thick, well tanned buckskin; it was thick but soft and pliable; on this he laid the obsidian flake, holding it firmly in its place by the first three fingers of the same hand; the elbow was steadied on the left knee. In his right hand he took the larger of the two deer prongs and commenced to reduce one edge of the circular form of the flake to a straight line with the thumb of the right hand resting on the edge of the left hand as a fulcrum. The point of the deer prong would be made to rest on about an eighth of an inch or less of the edge of the flake, then with a firm pressure of the point a conchoidal fragment would be broken out, almost always of the size desired. This operation was repeated until in a few moments the flake was reduced to a straight line on one edge; by rubbing this on the side of the deer horn the sharp edge was worn down. Next, the flake was turned end for end and the chipping renewed; when completed care was taken that the cutting edge was left in the centre. It was now plain that the straight edge thus made was to be one side of the long isosceles triangle, the form of the arrowheads which is used by the tribe. The other side was formed in the same manner and next the base. The chipping out of the slot by which the arrow head is firmly bound by deer tendon to the shaft was the simplest and most rapid portion of the work. It had taken forty minutes to split the two flakes from the obsidian mass and to form one of them into the arrow head. The detailed account of this most interesting process will be found, with illustrations, in the November number of the *American Naturalist*.

REV. JAMES CLIFTON WARD, F.G.S.

OUR geological readers will learn with sincere regret that one of the most earnest of the band of "workers" in this country passed away on April 15, aged 37. Early adducing a taste for science, Mr. Ward was sent to the Royal School of Mines in 1861, studying in the Geological Division, and obtaining the Associateship in 1864. In the following year he joined the staff of the Government Geological Survey, and was sent down to the Yorkshire coalfield, in the survey of which he took an active part. Under the superintendence of Prof. Green he contributed to the elucidation of the geology of seven ordnance quarter sheets, including at least twenty-three maps of Yorkshire, on the scale of 6 inches to the mile, to many Horizontal and Vertical Sections explaining the structure of the coalfield, and furnished information included in the Survey *Memoirs* on the Dewsbury and Huddersfield district, 88, N.E., in 1871, the Burnly Coalfields in 1875, and the "Geology of the Yorkshire Coalfield" in 1878, and was called before the Royal Coal Commission to give to them the results of his labours in that coalfield. In 1869 Mr. Ward was transferred to the Survey of the English Lake District, then commencing under the superintendence of Mr. Aveline, and we henceforth see Mr. Ward in a new light. Hitherto conscientious work and indefatigable industry had alone characterised him; but so soon as he was surrounded by the scenery of the Lakes, and breathed its exhilarating atmosphere, he developed, in addition to these qualities, a rare appreciation of its beauties, alike present in sunshine and in storm, not far removed from that "being one with nature" that is so marked a characteristic of the little band of poets which, in the time that has just gone by, have rendered this district, classic ground for the student of English literature. Keenly enjoying the impressions received from moor and mountain, the search after their origin, the elucidation of their past, and the restoration of their physical geology were ever present in his mind, pursued with a zest and an industry that only can be realised by those who have witnessed it. To pick up a line or clear up a doubtful point he would retrace his steps up the roughest and steepest ground, after a long day's tramp, at a speed that proved the curiosity and interest that he felt in its solution, and after the longest and hardest day in the field we have seen him working at his microscope into the small hours of the night, whilst early the next morning he was ever ready for fresh expeditions, in which no fatigue could check his interest and no discomfort try his good nature. The results of his labours in the Lake District are embodied in the "Keswick Quarter-Sheet" of the Geological Survey and the accompanying memoir on "The Geology of the Northern Part of the English Lake District," published in 1876, and in various official maps and sections, as well as in papers in the *Journal* of the Geological Society, the *Geological Magazine*, *Popular Science Review*, *Science Gossip*, and NATURE. To more fully understand the history of the volcanic rocks of his favourite Borrowdale, he undertook a journey to Italy to study Vesuvius and other volcanoes in that region. He spared neither time, cost, nor labour in microscopic sections of rocks and their chemical analyses, to aid his results in the field, and though some German petrographers have questioned some of his results worked out in the laboratory, we doubt whether any future observer will be able to suggest any improvement or change in the elaborate network of boundary lines covering the maps of the northern Lake District.

In his papers on the Lake District he pointed out the *radiate* arrangement of the ice from the higher grounds during the Glacial Epoch, and the fact that though the rock-basins were scooped out by ice, the amount denuded is an exceedingly small proportion of the entire valley, which was the product of a long period of denudation, and that the district afforded no evidence of a universal ice-cap moving across it in one direction. In his petrographical papers he deduces from "the liquid cavities in quartz-bearing rocks" that the granitoid rocks of the Lake District were consolidated at a depth not greater than 30,000 feet. Comparing the modern volcanic rocks of Vesuvius and Naples with the old lavas of the Lake District and North Wales, he refers the latter to the felstone group, and those of Cumberland to a group midway between the felstone and the basaltic; in both

Wales and Cumberland felspathic ashes being metamorphosed into felstone-like rocks.

Mr. Ward had always a strong bent towards educational work, and lectures of his first given to a school audience, and afterwards before the Keswick Literary Society, were expanded and published as text-books ("Elementary Natural Philosophy" and "Elementary Geology," 1872). Like the late Canon Kingsley with the Chester Society of Natural Science, Mr. Ward exerted an immense influence in attracting people to the pursuit of natural science, and in breaking down those trammels which prevent people of different ranks meeting for a common useful object; and not only increased the number of members of the Keswick Society and put its museum in scientific order, enriching it with his own collections, but united the society with the other societies of the county, and formed them into the Cumberland Association—a society publishing a useful journal. In 1878 he left the Geological Survey and entered the Church, holding successively two cures under the Bishop of Carlisle: the first, a curacy at Keswick; the second, the vicarage of Rydal. Thus in the shadow of Wordsworth's home, surrounded by the mountains he loved so well, he closed his useful, respected, and sadly too short life. C. E. R.

THE INSTITUTION OF MECHANICAL ENGINEERS

AT the recent meeting of the Institution of Mechanical Engineers four papers were read on subjects of practical interest to engineers and men of science, viz., on Electric Lighting, by Dr. John Hopkinson, F.R.S. Remarks on Chernoff's papers on Steel, by Mr. W. Anderson of Erith. On Permanent Way for Street Tramways, with special reference to Steam Traction, by Mr. J. D. Larsen; and on Water Pressure Engines for mining purposes, by Mr. H. Davey of Leeds.

Dr. Hopkinson's paper is divided into three principal parts. The first is a continuation of a paper read by the author in April, 1879, in which he exhibited by means of a curve the interconnection between the current passing through a dynamo-electric machine, the speed of revolution, and the electromotive force. Since the date of the author's earlier paper other electricians have made experiments in the same direction; notably Auerbach and Meyer in Germany, and Dr. Siemens, F.R.S., in this country. The results arrived at by these experiments are now given in a similar form to that adopted by the author for illustrating his own experiences.

The second part of the paper deals with the brightness of the electric arc. It is common to speak of the brightness of an electric light in terms of so many candles. The colour of the electric light is however different to that of a candle. Hence "the statement without qualification, that a certain electric lamp and machine give a light of a certain number of candles," "is wanting in definite meaning." "Captain Abney (*Proceedings* of the Royal Society, March 1878) has given the results of the measurements of the red, blue, and actinic light of electric arcs in terms of the red, blue, and actinic light of a standard candle." It has also been ascertained that the electric light under certain circumstances gives very different intensities of brightness in different directions. These two facts, together with certain practical difficulties, have rendered the measurement of the light emitted by the electric arc somewhat difficult. In the second part of his paper Dr. Hopkinson describes the methods which he has adopted for overcoming these difficulties.

In the third section the author considers the efficiency of the electric arc, and concludes by giving a rule for the "measurement of the efficiency of any system of electric lighting in which the electric arc is used, the arc being neither exceptionally long nor exceptionally short."

Mr. Anderson's remarks on Chernoff's papers on Steel are chiefly interesting as tending to direct attention to an almost unknown series of papers by a distinguished Russian metallurgist. Few men have had better opportunities for becoming acquainted with the nature of steel than M. Chernoff. He has been for some years assistant manager of the celebrated Abouchoff Steel Works, close to St. Petersburg. At these works five different processes of manufacturing steel, viz., the old crucible, the Siemens crucible, the Bessemer, the Siemens-Martin, and the Whitworth fluid compressed steel systems, may all be seen in operation. Visitors to the Vienna Exhibition in 1873 will remember the splendid specimens of artillery, including a breech-loading forty-ton gun, which were turned out by this factory. The establishment is provided with an admirable laboratory, with one of Kirkaldy's testing machines, and with every appliance necessary for investigating the nature and properties of the metal. Under these circumstances any contribution to our knowledge of steel coming from the pen of M. Chernoff would probably well deserve the attention of English metallurgists. The first of the papers referred to was published in 1868, but was not translated into English till 1876. It deals with the chemical composition of steel, the effects of introducing extraneous subjects into its composition, and the effect upon its properties and molecular structure of heating the metal up to various temperatures as high as the melting point, and then cooling it again from the melting point.

In 1876 M. Chernoff published a paper on the Bessemer Process, "which gives a number of interesting analyses made at the Abouchoff works and elsewhere, and institutes a comparison as to the dimensions of apparatus, quantity of air required, and other details, in different countries and for various qualities of iron."

In 1878 he produced a paper on the Structure of Cast-Steel Ingots, which deals with the nature and origin of the defects to be met with in ingots, and the proper method of obviating them. This paper also goes into the very important question of whether steel-castings do or do not require subsequent treatment under the hammer, and the author gives tables of experiments to show that by proper annealing steel-castings can be rendered "fully as tough, tenacious, and ductile as the forged metal."

Mr. Anderson has done good service by translating these papers for the benefit of English readers. He notices at the beginning of his own paper that the Russian language is so little understood that it is only by accident that the labours of many very distinguished Russians became known in Western Europe. We commend this remark to the attention of the editorial committee of the Institution of Civil Engineers. The *Transactions* of the Institution have for some time been remarkable for the admirable series of abstracts of papers published in foreign periodicals. No English engineer can now complain that the scientific publications of other countries are inaccessible to him, therefore it seems the greater pity that any little difficulty about the language should cause the labours of Russian *savants* to have been overlooked.

The latter portion of Mr. Anderson's paper has nothing to do with M. Chernoff. It deals principally with the effect which occluded gases seem to play in the hardening and tempering of steel, and also considers the molecular changes, and the variations in the specific gravity of steel brought about by tempering. On this point we should like to draw the author's attention to a most interesting series of experiments by Dr. Schott, a German, on the effect of tempering glass in oil; a *résumé* of which is to be found in the foreign abstracts of the last volume of "Transactions of the Institution of Civil Engineers."

A study of this paper may perhaps throw some light on the corresponding problems in the manufacture of steel.

Mr. Larsen's paper on the Permanent Way of Street Tramways is an eminently technical production, and deals with the forms of rails and nature of sleepers and cross-ties necessary to secure not only a good and permanent road for the present system of traffic, but also one which can be readily adapted to steam traction, whenever sufficiently perfect steam traction shall have been introduced to take the place of horses.

Tramways have not hitherto succeeded in earning the sympathy of those sections of the public who travel in cabs and carriages. Owing to the peculiar kind of rail used, and the imperfect manner in which the tramway proper has been combined with the paving of the ordinary road, street vehicles have experienced a very nasty and injurious species of wrench and jolt, when crossing the rails, which, besides being very uncomfortable to the occupier of the carriage, is also extremely injurious to his wheels. In addition to this drawback the earlier tramways were laid on a very bad system. They rapidly got out of order. Owing to the spikes which fastened down the rails having been driven down from the upper side, the rain used to percolate downwards between the spike and its holding in the sleeper, so that the wood of the latter became soft, and spike and rail consequently worked loose. In fact, in the older tramways it was the exception to find a rail in good order. The difficulty of setting the paving stones properly in the neighbourhood of the longitudinal timber sleepers was so great that the surface of the roadway almost invariably settled down thereabouts into a continuous longitudinal depression, which in wet weather became a stagnant ditch, not only unsightly, but extremely inconvenient to foot passengers and ordinary traffic. Mr. Larsen in his paper describes the various inventions and contrivances brought out by himself and other engineers for the purpose of remedying these drawbacks, and of making the permanent way so secure and rigid that it can be used at any time for steam traction.

The author does not refer to one of the greatest novelties in permanent-way construction, viz., the glass sleepers brought out by Mr. Lindsay Buckill and Mr. W. Siemens of Dresden. These sleepers have been laid down for some time past on a section of one of the Metropolitan tramway lines, and appear to have answered their purpose most successfully. The fact that glass, proverbially the most brittle of substances, could be used for such a purpose, might strike most people with surprise; but readers of Dr. Schott's paper, referred to above, will have learned that by suitable tempering glass may be made, mass for mass, stronger than steel, and practically unbreakable. We understand that the success attained in the construction of glass sleepers has recently been so great that it is now proposed to make broad longitudinal sleepers with a groove in the upper surface which shall combine in themselves the functions of rail and sleeper, and do away with the necessity for separate iron rails with their fastenings, joints, and other concomitant complications.

Mr. Henry Davey's paper on water-pressure engines for mining purposes would scarcely be understood without reference to the diagrams and illustrations made use of by the author. Its character is moreover so essentially technical as to render it unsuited for reproduction in this journal.

NOTES

WE take the following from the *Times*:—The following are the names of the fifteen candidates for the Fellowship of the Royal Society selected by the Council and recommended for election (Thursday, June 3, is the day appointed for the election):—Dr. Clifford Allbutt, Prof. J. Attfield, Mr. H. E. Blanford, the Rev. W. H. Dallinger, Mr. Thiselton Dyer, Lieut.-Col. Godwin-Austen, the Bishop of Limerick, Prof. D. E. Hughes, Mr. H. M. Jeffery, Prof. F. M'Coy, Mr. J. F. Moulton, Prof. C. Niven, Dr. J. Rae, Prof. J. E. Reynolds, Dr. W. A. Tilden.

PROF. BAYLEY BALFOUR returned last week from Socotra, with considerable botanical and zoological collections made during his necessarily very brief visit. He obtained dried specimens of 500 species of flowering plants, and four cases of living specimens, besides a large plant of the *Dracæna*, which yields the dragon's blood of Socotra, and which, till recently, was quite unknown to science. He attempted to convey with him through Italy a small case of succulent plants of special interest, but it was stopped at the Custom House at Brindisi, and unless it finds its way to England by the sea route, its contents are of course lost.

WE regret to learn of the death, after a short illness, of Mr. W. H. Holloway, F.G.S., of the Geological Survey of England and Wales.

THE Portuguese Naturalist Anchietta has recently sent from Africa 2,000 specimens of birds and 1,000 reptiles, fishes, insects, and other animals, besides numerous specimens of plants and rare minerals. They are intended for the Polytechnic Museum of Lisbon.

THE *Newcastle Chronicle* announces the death, at Gosport, of Mr. Thomas Atthey, a naturalist of considerable reputation. Although living in comparative obscurity and quiet, he was well known and highly esteemed in learned circles for his researches in and contributions to that branch of science to which he was so much attached, his position being very much akin to that of Thomas Edwards.

THE *Irish Farmers' Gazette* understands that Prof. Baldwin is about to retire on a well-earned pension from the appointment he has so ably filled for many years as Superintendent of the Agricultural Department of the National Board, Dublin.

THE Dharwar correspondent of the *Bombay Gazette* gives a graphic account of a thunderstorm which occurred on March 24 last, and was accompanied by a fall of some very heavy hailstones. "The storm," the correspondent states, "was ushered in by the fall of some extremely heavy hail, several of the largest stones, which were *spherical* in shape, measuring no less than *nine or ten inches in circumference*. He did not himself see these monster hailstones, but he vouches for the accuracy of this statement. He picked up several hailstones, however, himself, which were the size of Tangier oranges. Accompanying this storm of hail were thunder and lightning, both on a grand scale, the latter at times being very vivid. After the hail came a heavy downpour of rain, and the whole affair was over by about 8 p.m. One piece of ice was picked up about five inches long and pointed at one end." The correspondent who sends us this writes: "It is a pity that these remarkable hailstones were not more closely examined and measured. Of course there are cases on record of still larger stones having fallen, especially in tropical countries."

THE programme of the annual meeting of the Iron and Steel Institute, to be held on May 5, 6, and 7, has just been issued. The Bessemer medal for 1880 is to be presented to Sir Joseph Whitworth, and among the papers to be read and discussed are the following:—"On Hardening Steel, its Causes and Effects;" "Physical Changes occurring in Iron and Steel at High Temperatures;" "Manufacture of Bessemer Steel and Ingot Iron from Phosphoric Pig;" "Dephosphorisation of Iron at the Hördeworks, Germany;" "Reactions in the Open-hearth Process;" "Improved Method of Utilising By-products in the

Manufacture of Cake;" and "Improved Apparatus for Analysing Blast Furnace and other Gases."

PROF. HUMPHRY, F.R.S., has been appointed Rede Lecturer for this year.

A RUMOUR has been spread in all the French papers and in some of our English contemporaries, that a war balloon had exploded at Meudon, and an officer with some privates severely wounded. We are happy to be able to state on official authority that this statement has no ground whatever, in spite of its precision.

M. BISCHOFFSHEIM, the well-known Paris banker, a native of Amsterdam, is to be naturalised, without being subjected to the usual formalities, as a compliment for his munificence towards scientific and other objects.

THE elections for the Superior Council of Public Instruction in France took place last week. The Institute sent five delegates, one from each class, the College de France two professors, the Museum of Natural History one, the Polytechnic School one, the Normal School two, the Conservatoire des Arts et Métiers one. The other delegates were selected all over France by the several delegations of private teachers voting by categories. The counting of these votes took place at the Ministry of Public Instruction. Amongst the delegates are M. Jules Simon, the former Minister of Public Instruction, M. Bertrand, the Perpetual Secretary of the Academy of Sciences, M. Fremy, the former President of the Academy of Sciences, M. St. Claire Deville, M. Berthelot, M. Hervé-Mangon the Director of the Conservatoire of Arts, and M. Laussedat, the former Director of the Meudon Aëronautical School.

THE *Daily News* states that we have to thank the heliograph again for an important message received from General Stewart, and announcing the result of an attack on our troops, in which the enemy seems to have suffered severely. The message is dated Camp Ghuzni, April 22, and was received at the India Office the following day. It is very probable that the news could not have been brought so speedily by electric telegraph. The heliograph does not require the route to be kept open. The line of communication cannot be cut, for the simple reason that the signalling takes place over the heads of the enemy, and the stations required are but few and far between. A 10-inch mirror, and this is the diameter of the ordinary field heliograph, is capable of reflecting the sun's rays in the form of a bright spot, or flare, to a distance of fifty miles, the signal at this interval being recognisable without the aid of a glass. That is to say, two trained sappers, each provided with a mirror, can readily speak to one another, supposing the sun is shining, with an interval of fifty miles between them, provided their stations are sufficiently high and no rising ground intervenes to stop the rays. The adjustment of the military heliograph is a very simple matter. An army leaves its base where a heliograph station is located, and after travelling some miles desires to communicate with the stay-at-homes. A hill in the locality is chosen, and a sapper ascends with his heliograph, which is simply a stand bearing a mirror swung like the ordinary toilet looking-glass, except that besides swinging horizontally it is also pivoted so as to move vertically as well. Behind the mirror, in the very centre, a little of the quicksilver has been removed, so that the sapper can go behind his instrument and look through a tiny hole in it towards the station he desires to signal. Having sighted the station by adjusting the mirror, he next proceeds to set up in front of the heliograph a rod, and upon this rod is a movable stud. This stud is manipulated like the foresight of a rifle, and the sapper again, standing behind his instrument, directs the adjustment of this stud until the hole in the mirror, the stud, and the distant station are in a line. The heliograph is then ready to work, and in order to flash signals so that they may be seen at a distance, the sapper has only to take care that his mirror reflects the sunshine on the stud just in front of him.

AN open competition for one situation of Junior Second Assistant in the Herbarium, Royal Gardens, Kew, will be held in London, under the following regulations, on Tuesday, May 25, 1880, and following days. No person will be admitted to the examination from whom the Secretary, Civil Service Commission, has not received, on or before May 15, an application on the prescribed form. The examination will be in the following subjects, viz:—(1) Handwriting, (2) Orthography, (3) Arithmetic (elementary), (4) Elements of Systematic and Structural Botany, (5) the naming of plants by the British Flora. Candidates will be required to show what preliminary training or technical education they have undergone to qualify themselves for a situation of this nature, and they must satisfy the Civil Service Commissioners that they possess the special qualifications necessary for the office. The salary of the Junior Second Assistant in the Herbarium is 100*l*. per annum, rising by annual increments of 10*l*. to 150*l*. per annum.

SHOCKS of earthquake were felt at Nice at 2 p.m. on Sunday.

THE Municipal Council of Paris have visited the peninsula of Gennevilliers, to ascertain the results of irrigation with the discharge from the sewers. These have been found splendid, and the agricultural population of the district is very well satisfied with them. Other lands are to be found for utilising the remaining part of the sewage of Paris. The city engineers proposed to irrigate land in the vicinity of the forest of St. Germain, but the inhabitants have sent petitions against the project, and deputations have met the Municipal Council. At all events, it is supposed the opposition will be overruled by the city authorities, unless Parliament vetoes the further extension of sewage irrigation.

NEWS has just reached Shanghai respecting the progress of the scheme for establishing a woollen manufactory at Lanchow-fu, in the extreme north-west of China Proper, to which we alluded about a year ago. Mr. Hagge, one of the foreigners employed at it by the Chinese Government, has just returned to Hankow and Shanghai; he states that no difficulty is experienced by the natives in working the machinery, and that the sheep's wool supplied is of the finest quality, a great deal of camels' wool also being used. It is perhaps worthy of note that the Chinese in that region live almost entirely on meat and wheat flour. Mr. Hagge's journey from Lanchow-fu to Hankow occupied fifty-two days.

FROM the *Japan Herald* we gather some particulars respecting the earthquake at Yokohama on February 22, the most serious one which has occurred in Japan since 1855. The Government some years ago, established the necessary apparatus at Tokio for registering the duration, force, &c., of earthquakes, by which it appeared that the first shock took place at 0h. 49m. 22s. a.m., and lasted fourteen seconds; the second was at 0h. 50m 19s., and lasted only six seconds, but it was far more severe than the first, and did much damage. There was a third and less violent shock thirty seconds later, but no record is given of its duration. The index of the stenograph showed that the second shock was from N.N.W. to S.S.E., and the force of the shock was registered at 79 degrees.

THE *Report* of the Geological Association for 1879 complains, like the recent reports of other societies, of the few additions to its membership during the past year, no doubt mainly owing to the general depression. The Society now numbers 415 members.

FROM Tokio, Japan, we have received a little pamphlet on "Japanese, Metric, and English Weights and Measures," by Mr. Edward Kinch, compiled for the use of the students of the

Imperial Agricultural College of Tokio. The tables include mensuration and mechanical formulæ, and physical, chemical, and physiological memoranda and constants.

"NOTES on the Alluvial and Drift Deposits of the Trent Valley near Nottingham," is the title of a lecture to the Nottingham Naturalists' Society by Mr. James Shipman, published by Norris and Cokaigne, of Nottingham.

NO. 1 of the *Transactions* of the Cremation Society of England has been issued by Smith, Elder, and Co.; it contains a short history of the subject of cremation at home and abroad, up to the date of the sixth anniversary of the Society, on January 13 of this year.

As proof that fat is formed from albumen, the affirmation of Blondeau (*inter alia*) is sometimes cited, that in the cellars at Roquefort the albumen of the cheese kept there is changed to fat by action of the fungus present. This has been often doubted, and recently Herr Sieber has given (*Journal für praktische Chemie*, Bd. xxi. p. 203) experimental evidence of its falsity. He analysed fresh cheese, cheese that had remained one month in the cellar, and quite old cheese. His figures prove that the most marked change which cheese undergoes in ripening is the loss of water. The proportion of fat remains unaltered, if only the dry substance be considered. (The apparent increase of fat represented in the three percentage figures 27·41, 31·23, and 40·13 is due to drying.) The second essential change of cheese in ripening consists in the decomposition of albumen; the casein passes into a series of decomposition-products, which are pretty similar to products of putrefaction in the first stages of putrefactive fermentation. But these analyses show no transformation of albumen into fat.

FROM a circular which has been sent us we learn that the "Studies from the Biological Laboratory of the Johns Hopkins University," will appear in parts from time to time as sufficient material accumulates; and will contain original papers upon Physiology, Animal and Vegetable Morphology, and Embryology, published by members of the University in different scientific journals, and other papers which are not printed elsewhere. The publication will be based upon the investigations made by members of the University in the biological laboratory, and in the marine zoological station of the University. Each part will contain about 100 pages, and four parts will make a volume. The first volume is now complete, and contains 519 pages, and 40 plates, besides illustrations in the text: with the following table of contents. Vol. I., part 1, contains:—The normal respiratory movements of the frog and the influence upon its respiratory centre of stimulation of the optic lobes, by H. Newell Martin. The development and regeneration of the gastric glandular epithelium during fœtal life and after birth, by H. Sewall. The influence of stimulation of the midbrain upon the respiratory rhythm of the mammal, by H. Newell Martin and W. D. Booker. The botanical relations of *Trichophyton tonsurans*, by I. E. Atkinson. Preliminary observations upon the development of the marine prosobranchiate mollusca, by W. K. Brooks. With four plates and three illustrations in the text; price 1 dollar. Vol. I. part 2, contains:—On the respiratory function of the internal intercostal muscles, by H. Newell Martin and Edward Mussey Hartwell. Observations on the physiology of the spinal cord, by Isaac Ott. On the effect of two succeeding stimuli upon muscular contraction, by Henry Sewall. On the so-called heat dyspnœa, by Christian Sihler. A self-feeding chronograph pen, by H. Newell Martin. Observations upon the early stages in the development of the fresh-water pulmonates, by W. K. Brooks. The development of *Amblystoma punctatum*, by S. F. Clarke. With twelve plates; price 1 dollar. Vol. I. part 3 (Chesapeake Zoological Laboratory; scientific results of the session of 1878), contains:—Introductory, by W. K. Brooks. Land Plants found at Fort Wool, by N. B. Webster. List of animals found at Fort Wool, by P. R. Uhler. The development of Lingula, by W. K. Brooks. Lucifer typus, by Walter Faxon. The development of Gasteropods, by W. K. Brooks. The development of Squilla, by W. K. Brooks. With thirteen plates; price 1 dollar. Vol. I. part 4 contains:—The development of the American oyster, by W. K. Brooks. The acquisition and loss of a food-yolk in molluscan eggs, by W. K. Brooks. With eleven plates; price 1 dollar. The editors wish to exchange this publication with the publications of scientific societies and scientific journals. The publishers are J. Murphy and Co., Baltimore, Md., U.S.A.

THE *Revue Scientifique* for April 24 has a long essay by M. J. Thoulet, on the Mineralogy of Homer.

MR. MOSELEY asks us to state that in the report of his lecture on Deep-Sea Dredging and Life in the Deep Sea (NATURE, vol. xxi. p. 543), "Four-elevenths, or nearly three-fourths," should stand "eleven-fifteenths," κ.τ.λ.

THE additions to the Zoological Society's Gardens during the past week include a Cape Hunting-Dog (*Lycaon pictus*) from South Africa, presented by Mr. C. Ernest Pope; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Capt. Fife; a Green-Winged Trumpeter (*Psophia viridis*) from Maranham, presented by Mr. R. M. Hyde; a Blue-fronted Amazon (*Chrysotis æstiva*) from South America, presented by Miss E. Bentley; a Black Scoter (*Œdemia nigra*), European, presented by Mr. J. E. Harting, F.Z.S.; a Long-Eared Owl (*Asio otus*), European, presented by Capt. C. A. Lumsden; a Stump-Tailed Lizard (*Trachydosaurus rugosus*) from Australia, presented by Capt. J. Thomas; a Common Adder (*Vipera berus*), British, presented by Mr. W. H. B. Pain; a Drill Baboon (*Cynocephalus leucophæus* from West Africa, deposited; two Common Seals (*Phoca vitulina*), British Seas, purchased; two Jameson's Gulls (*Larus jamesoni*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

THE GREAT COMET OF 1843.—Now that the identity of the southern comet of the present year with that which excited such unusual attention in almost all parts of the globe in March, 1843, is pretty well established, it is not without interest to recall the circumstances under which the comet then made its appearance.

There were vague reports that the tail had been remarked before the perihelion passage (February 27) at Bermuda, Philadelphia, and Porto Rico on February 19, 23, and 26, and, according to Encke, the German newspapers had a notification from New York, that the comet was seen as early as February 5, and six days later was observed near β Ceti. These statements did not receive confirmation. The first definite observation of the head of the comet, and the only one previous to perihelion passage, was claimed to have been made by a Capt. Ray, and is described in a letter from Mr. Mitchell, of Nantucket, published by Prof. Peirce, the well-known American geometer. Capt. Ray is said to have been "a man of sound judgment, a very accurate observer, and correct man." He says he saw the comet nearly at midday at Concepcion, S.A.; at 11 a.m. its bearing from the sun was almost precisely east, with very little perceptible southing; "he did not measure the angle, his instruments being on board of the ship, some distance below the city; but he took great pains to estimate the apparent distance, and, being so near the sun, thinks he has done it very nearly," as Mr. Mitchell reported. The comet's "distance from the sun was only five minutes, or one-sixth of the sun's apparent diameter." It is not easy to understand how an object could have been detected without instruments, at a distance of only five minutes from the sun's limb, and it is certain that the elements which represent the observations after perihelion very closely, place the

comet at 11 a.m. at Concepcion on February 27, much further distant; according to Hubbard's parabolic orbit, the comet was then 1° 55′ from the sun's limb, and its hourly motion at the time was − 15″·4 in right ascension and + 4′·5 in declination; Prof. Peirce remarked, "the Concepcion observation, if it was made with anything of the accuracy which might be expected from Capt. Ray, exhibits a decided anomaly in the nature of the forces to which the comet was subjected during its perihelion passage," and it is only in this connection that the observation requires to be noted; there still remains the difficulty of explaining how Capt. Ray's attention could have been called to an object distant only 5′ from the sun's limb.

On February 28 the head, with a tail several degrees in length, was observed at noonday in various parts of Italy, off the Cape of Good Hope, and at different points in the United States, and in Mexico. Bianchi, writing from Modena, states that on this day, the sky having been perfectly clear up to noon, great numbers of persons at Bologna, Parma, at the Villa de Colorno, and at Genoa, from 10h. 45m. to 11h. 45m., saw "a kind of star," a little distance from the sun to the east, which shone very vividly—"malgré la proximité apparente du soleil dont il fallait seulement se mettre à l'abris de la vue directe par l'interposition d'une mureille"—from which a bright tail extended towards the east for four or five degrees. The passengers and others on board a vessel, then off the Cape of Good Hope, remarked the comet distinctly about the same hours, and rather later, as we have mentioned, it was discovered at different places in the United States. The only observations of position made there which have any pretensions to accuracy were obtained by Mr. Clarke of Portland, Maine, who measured the distance of the nucleus from the sun's limb soon after 3 p.m. Mr. Bowring, at Chihuahua in Mexico, took with a sextant double-altitudes of comet and sun on the same afternoon. Unfortunately, notwithstanding the comet was so widely observed in Italy, its place was nowhere accurately fixed, but motion was detected, as appears from a letter of Amici to Arago, communicated by the latter to the Paris Academy. Amici wrote that his son, traversing the Place Calderini at Bologna, remarked a group of persons whose attention was directed to a comet. He saw it as a luminous mass, distant from the sun eastward more than two solar diameters. When viewed with an opera-glass it resembled a small flame, with ill-defined contours, three times as long as broad, very luminous on the side next the sun, and a little smoky to the east. At 1 p.m. its position was south of the sun's lower limb; "at 3 p.m. its motion towards the east had already produced a decided displacement."

The tail was remarked on the evening of March 1 in southern latitudes, and on March 5 precise observations of the nucleus were commenced after sunset at the Royal Observatory, Cape of Good Hope; the nucleus had been seen at Buenos Ayres two days earlier. The tail was detected at Lisbon on March 8, and the nucleus on March 12. At Montpellier M. Legrand saw the comet on March 11 at 7h. 15m., and described its light as of a "couleur rouge, très-prononcée;" this redness, he states, was equally noticeable on March 13, but on the following evening the train was white. The ruddy colour was disputed by other observers.

In those pre-telegraphic days we were without intimation of the comet's appearance before March 17, on the evening of which day in this country, as in most parts of Europe, the tail attracted general attention. It was considered at the time that the only certain glimpse of the nucleus obtained in England was by Sir John Herschel, at Hawkhurst, Kent.

THE COMET 1880 *b* (SCHABERLE, APRIL 6).—Admiral Mouchez, Director of the Observatory of Paris, has communicated to the Academy of Sciences observations of the comet detected at Ann Arbor, Michigan, made by MM. Henry and Bigourdan on April 8, 12, 16, and 18. The comet has a nucleus as bright as a star of about 11m., and a fan-shaped tail of 3′ or 4′. From the observations of April 8, 12, and 18, Mr. Hind has deduced the following rough approximation to the elements of the comet's orbit:—

Perihelion passage 1880, July 17·8675 G.M.T.

	°	′
Longitude of perihelion	100	44
" ascending node	260	11
Inclination	57	28
Logarithm of perihelion distance	0·21371	

Motion—retrograde.

A calculation by MM. Holetschek and Zelbr of Vienna, founded on observations of April 10, 11, and 13, give the date of perihelion passage, June 11, and the longitude of perihelion 122° 43′, but it is a case where these elements are not likely to be accurately fixed by the earlier computations.

The following positions are derived from the above orbit:—

12h. G.M.T.	R.A. h. m.	N.P.D. ° ′	Log. Distance from Earth.	Log. Distance from Sun.
April 30	6 14·9	22 49	0·3374	0·2872
May 2	6 15·3	24 5		
4	6 15·8	25 18	0·3453	0·2810
6	6 16·4	26 30		
8	6 17·2	27 40	0·3531	0·2750

GEOGRAPHICAL NOTES

THE medals annually given by the Royal Geographical Society for competition among the principal public schools have been awarded as follows:—Physical Geography (Examiner, Commander V. L. Cameron), Gold Medal, David Bowie, Dulwich College; Silver Medal, A. L. Humphries, Liverpool College. This medal was awarded by the Examiner to F. Taylor Sharpe, of Liverpool College, who had gained it in 1879, and was, therefore disqualified. Political Geography (Examiner, Admiral Sir Erasmus Ommanney), Gold Medal, Frederick Jas. Naylor, Dulwich College; Silver Medal, Theodore Brooks, London International College.

AT the meeting of the Geographical Society on Monday evening, the Rev. C. T. Wilson, of the Church Missionary Society's Nyanza Expedition, who has just returned to England from Lake Victoria, read a paper on Uganda and its people. The three Waganda chiefs who had accompanied him and Mr. Felkin were present at the meeting. After recording his movements since 1876, Mr. Wilson gave a general description of the physical aspect, climate and products of Uganda, adding some remarks on the people, their constitutional arrangements, the tenure of land, &c. Since Capt. Speke's time there had been a considerable improvement among the Waganda, who had taken to wearing cloth, and had become very teachable, some learning to speak Arabic and read Swahili in the Roman character, at the mission station. The folk-lore and traditions of the country afford a very promising field for research, and Mr. Wilson gave an amusing instance in the reputed adventures of one Kinto with the gods. The language belongs to the Bantu group, and is an agglutinative one. It has, of course, to be reduced to writing by the missionaries, who have found twenty-four Roman letters sufficient for the purpose. Mr. Wilson stated that he had made a collection of 5,000 words, as well as of fables, stories, and songs. Reverting to the subject of geography, Mr. Wilson averred that German and other writers had given erroneous names to the lake, and that its true and only name was Nyanza or Nyanja—a term which rightly belonged only to it. In the course of a general outline of the configuration of the lake coast, Mr. Wilson dwelt on the peculiar and large group of islands—the natives say 400 in number—at the north-west corner of the lake, which are very beautiful as to scenery, but separated by difficult and intricate channels. The characteristics of the shore are at present but little known, a remark which particularly applies to the north-east corner, and generally the lake is very imperfectly mapped. As is the case with Lake Nyassa, squalls are the great danger of the Nyanza, and there are also some peculiar currents which require investigation. Mr. Felkin, who had formed one of the expedition sent up the Nile at the end of 1878, and had spent some three months at the lake, afterwards read some desultory notes relating chiefly to the homeward journey, in which he drew a terrible picture of the condition of the Egyptian equatorial provinces since the suppression of the slave-traders' rebellion.

As might have been expected, the reception of Prof. Nordenskjöld and his fellow-voyagers at Stockholm was of the most enthusiastic kind. The *Vega*, escorted by about 200 steamers, arrived at half-past ten o'clock on Saturday night. The adjacent coasts were lit up for a distance of many miles, and the city itself was splendidly illuminated. Near the landing-place a special platform was erected, where Prof. Nordenskjöld and his companions were received and congratulated by the municipal authorities. They proceeded immediately afterwards to the Royal Castle, where they were welcomed by the Kings Prof. Nordenskjöld subsequently drove through the city to hi.

residence in the Academy of Sciences, being vociferously cheered on the way by the dense crowds assembled to witness his return. Prof. Nordenskjöld has been created a Baron, and Lieut. Palander and Mr. Oscar Dickson (who so largely contributed to the expense of the expedition) have received patents of nobility. The latter has, in addition, received the Grand Cross of the Order of the North Star. M. Sibiriakoff, another liberal supporter of the expedition, has been appointed Commander of the same Order.

THE long-expected map of Palestine, drawn in twenty-six sheets, on a scale of 1 inch to the mile, after the surveys of Lieutenants Conder and Kitchener, R.E., is now reported as complete and ready for publication. It has been photozincographed, under the superintendence of Col. Cooke, R.E., the Director-General of the Ordnance Survey, for the committee of the Palestine Exploration Fund. The first issue will be to the 250 holders of the special edition of the memoirs and map, as a first instalment of that work. It will afterwards be forwarded to the general subscribers of this fund, and will then be issued to the public. The survey of the country was accomplished between January, 1872, and September, 1877, since which time the maps have been laid down, the memoirs written, the observations calculated, the hills drawn, and the sheets lithographed. The whole of the work, except the colouring, has been executed by officers and men of the Royal Engineers. The general editors of the maps and memoirs are Major Anderson, C.M.G., R.E., and Prof. E. H. Palmer, of Cambridge.

MR. WHYMPER has succeeded in carrying out part of his South American programme by ascending to the summit of Mount Chimborazo. Dr. Nachtigal, in reference to this, states at a recent meeting of the Berlin Geographical Society, that a Frenchman, Jules Remy, professed to have accomplished the feat in 1856, but it is very doubtful if he actually did. He gave the height as 7,328 metres, whereas it is 1,000 m. less. Humboldt observed the height trigonometrically to be 6,530 m., and Reiss, as the result of three measurements, found the highest of the two peaks to be 6,310 m., and the other 6,269 m. Humboldt in 1802 attempted the ascent, but only reached a height of 5,878 m., while Boussingault with Hall, in 1831, reached a height of 6,004 m.; these attempted it from the south side, while Dr. Stübel, from the north side, reached a height of 5,810 m. After an inspection of ten days Mr. Whymper made three attempts, and on the third succeeded in mounting both peaks. The night before the final ascent he spent at a height of 5,227 m.

THE *Voix* has received a letter from the Russian Consul at Sydney, M. S. Paul, dated February 4 (16), in which he states that he had received a letter from Dr. Miclucho-Maclay, of date November 28 (December 10). The explorer was then at Simbonn, one of the Solomon Islands, and proposed to visit the Louisiade and Solomon Archipelagos, which would occupy him about six months, when he would return to Sydney.

THE Russian Geographical Society will receive from the Government a subsidy of 14,000 roubles yearly, to found and maintain meteorological stations at the mouth of the Lena and on the islands of New Siberia.

L'Exploration states that early in March Mount Argacus (Ardjieh Dagh), in the Anti-Taurus chain, Asia Minor, 12 kilometres from the town of Kaisarieh, broke out in eruption. Its height is estimated at 3,991 metres above the sea. M. A. Synnet, of the Imperial Lycée of Galata-Serai, writing to the *Stamboul* on the eruption, states that Mount Argacus had its origin in volcanic eruptions which have taken place from the lower tertiary to the fourth century A.D. The surface occupied by the lava is greater than that of the Island of Corsica. The mountain is composed exclusively of dolerite, trachyte, and basalt. Claudius and Strabo speak of the mountain as then active.

WE hear from Washington that the Government printer has been authorised by Congress to put to press a second edition of the "Narrative of the North Polar Expedition of the U.S. Ship *Polaris*" (noticed in NATURE, vol. xvi. p. 225), under the command of Capt. C. F. Hall, as soon as orders for a thousand copies have been received.

THE new *Bulletin* of the Belgian Geographical Society contains M. Cambier's report to the International African Association on his journey from Tabora to Karema on Lake Tanganyika, accompanied by a sketch map of his route. There is also a report of the recent annual meeting of the Association.

THE chief paper in the last part of the *Transactions* of the Asiatic Society of Japan is one by Mr. R. W. Atkinson descriptive of a journey through the provinces of Shinshiu, Hida, and Etchiu, during which he visited the mountains known as Yatsuga-take, Haku-san, and Tate-Yama. There is also a proposal by Mr. W. G. Aston for the arrangement of the Corean alphabet.

PHYSICAL NOTES

PROF. MARANGONI has lately experimented (*Riv. Sci. Ind.*, March 15) on the diathermanous power of films of soapy water. A series of equidistant films (eight to ten) were produced in a wide vertical glass tube, and horizontal heat-rays from a smoked plate having a temperature of about 400° were directed down the tube by means of a metallic mirror, a second mirror below directing them to a thermopile communicating with a Weber magnetometer. The conclusions arrived at from the tabulated numbers are these: 1. The first of the films, notwithstanding its great tenuity, absorbs more than half the incident heat, reducing it (as expressed in the magnetometer deflections) from 38 to 18. 2. The successive films produce decrements, as theory indicates; the differences of their logarithms are sensibly constant (on an average 7·5), and the logarithms themselves, after the second film, decrease proportionally to the number of the films. 3. The diminution of intensity observed must depend very little on reflection, but be due almost wholly to absorption. Indeed the first two films act like a sieve, intercepting, probably, the less refrangible rays in very large proportion, such as would hardly have been expected. 4. A given film becomes more diathermanous the thinner it becomes. 5. When various salts are mixed with the soap solution the diathermanous power is not sensibly affected. All these conclusions are in full agreement with the results of Melloni and with the theory of the phenomenon.

IN a recent paper to the Vienna Academy on the photochemistry of silver bromide, Dr. Eder gives the result of a large number of experiments relating to latent actions of light connected with the chemical development. It is first proved that silver bromide behaves differently, as it is brought to an emulsion in an indifferent material (*e.g.*, collodion) or an easily oxidable organic substance (*e.g.*, gelatine); also the influence of this circumstance and of the presence of variable quantities of silver nitrate or of soluble bromide on the sensitiveness to light is carefully studied, special regard being had to the passage of silver bromide into its different modifications and the consequent different photo-chemical behaviour. Oxidising acids are especially prejudicial to the light-sensitiveness, other acids less so, and still less alkaline chlorides and bromides. Alkalies increase the light-sensitiveness considerably. For a highly sensitive silver-bromide preparation the addition of ammonia to the finely-divided granular bromide of silver modification, in the form of a gelatine emulsion, is recommended. Temperature and moisture have no marked influence on the sensitiveness to light, but the quality of the developer has. The view is expressed that in chemical development of the latent image, electro-chemical processes must have a part. Mechanical pressure (which especially modifies the behaviour of silver iodide to physical developers), is without action on the behaviour of silver bromide to chemical developers. Dr. Eder cites some other decompositions of silver bromide, which resemble the "latent action" of light, and may be induced by prolonged treatment with *weak* means of reduction. Lastly, it is pointed out that silver bromide *with chemical development* is greatly superior to silver iodide, which *with physical development* exceeds all other silver haloid salts in sensitiveness, and herein it is nearly equalled by silver chloride.

FROM recent experiments by a new method on heat-conduction in liquids (a subject on which very conflicting results have been recorded), Herr F. H. Weber concludes that the heat-conducting power stands (without exception) in closest connection with the specific heat of unit volume. Comparing the conduction of heat in a metallic liquid (mercury) with that in transparent non-metallic liquids, he considers it depends on essentially different "moments" in the two cases. In the non-metallic liquids it seems to consist in a simple transference of the kinetic energy of the moved ponderable molecules from layer to layer, whereas in metallic liquids it would appear that the *internal* radiation from layer to layer is the essential element, the other being here of only secondary importance. This, in Herr Weber's opinion, throws quite a new light on the analogy between the heat

conductivity and the electric conductivity of metals. These researches are described to the *Vierteljahrschrift* of the Zurich *Naturforschende Gesellschaft*, 1879, Bd. xxiv. p. 252.

THE INDIA MUSEUM ZOOLOGICAL COLLECTIONS

THE following letter on this subject has been sent us for publication :—

British Museum, March 17, 1880

MY LORD,—I am directed by the Trustees of the British Museum to acquaint your Lordship that Dr. Günther, the Keeper of the Department of Zoology in this Museum, has reported to them that he has completed the work of selecting from the zoological collections of the India Museum the specimens required for the British Museum, and of distributing the remainder among other institutions.

The accompanying extract from Dr. Günther's report shows in detail what has been done with those specimens which formed part of the India Museum, and what is proposed with reference to certain other specimens not included in the general transfer to the Trustees. I have, &c.,

(Signed) EDW. A. BOND

The Right Honourable the Secretary of State for India, &c., &c.

ZOOLOGICAL COLLECTIONS FROM THE INDIA MUSEUM

Extract from Report to the Trustees of the British Museum, by Dr. Günther, Keeper of the Department of Zoology. Dated March 8, 1880

1. For the British Museum have been selected and retained :—

672 Mammalia (mounted, or in skins, skeletons or skulls).
6,409 Birds.
125 Fishes.
28 Tortoises.
217 Mollusca.
83 Crustacea.
1,813 Insecta.
52 Radiata.
60 Jars and preparation of Economic Animal Products (besides some objects of manufacture transferred to the Ethnographical Department).

The Documents relating to the Zoological collections :—

2. A selection of the remainder was offered in succession to the Indian Museum, Calcutta; the Indian Institute, Oxford; the South Kensington Museum; the Dublin Museum; the Museum of Scarborough; and the Museum of Maidstone; the three first having been specially mentioned by the India Office as deserving precedence of other institutions.

a. The Agent of the Calcutta Museum selected :—

53 Mammalia and 3 Skulls of Mammals.
A series of named shells.
3,140 Named Insects.
A box of miscellaneous Insects. (The number of bird skins to be sent is not yet determined.)

b. Prof. Monier Williams, on behalf of the Indian Institute, Oxford, took the bulk of the remaining specimens, entering at the same time into an engagement to return them to the Trustees in case the project of the Institute were not carried out; he received :—

118 Mammalia.
37 Skulls and heads of Mammalia.
49 Horns of Mammalia.
2 Boxes containing various bones.
1 Narwhal's tusk.
1 Picture of a Flying Fox.
426 Stuffed Birds.
3 Boxes of Bird-skins.
5 Birds'-nests.
125 Bottles containing Reptiles and Fishes.
44 Stuffed Reptiles.
2 Models of Snakes.
1 Case of Stuffed Snakes.
94 Stuffed Fishes.
4 Models of Fishes.
1 Cabinet with Mollusks.
1 Box with Shells and Corals.
2 Boxes with Pearl Oysters, &c.
2 Boxes with Gorgonia.
2 Cases with Crustaceans.
5 Cabinets with named Insects.
10 Old Store boxes with various Insects.
2 Echinoderms.
1 Neptune's Cup.
1 Cabinet with Miscellaneous Specimens; Eggs, Nest, Crustaceans, Shells, &c.
1 Box of Sterna of Hodgson's Birds.

c. The South Kensington Museum took the whole of the collection of Economic Animal Products left after the selections for the British Museum and Kew had been made; the latter establishment receiving, by a special arrangement with the India Office, all products of silk and lac.

d. The Agent of the Science and Art Museum, Dublin, selected :—

7 Stuffed Mammals.
8 Skulls of Mammals.
1 Horn of *Cervus duvancelii*.
5 Tortoises.
4 Bottles containing Reptiles.

e. The Agent of the Philosophical Society of Scarborough selected :—

10 Mammalia.

f. The Agent of the Museum of Maidstone took the whole of the remaining specimens, viz. :—

103 Stuffed Mammals.
10 Skulls.

Before commencing the work of distribution Dr. Günther received intimation from Dr. Birdwood that certain specimens were not included in the general transfer to the Trustees, viz. :—

1. Four small cases of stuffed Birds from Kashgar and an Ibex, belonging to Dr. Bellew, and lent by him to the Indian Museum for exhibition. These specimens would be a valuable acquisition to the British Museum, and therefore Dr. Günther has written to Dr. Bellew, who is at present in Afghanistan, that he would propose to the Trustees to continue the custody of them until instructions shall have been received from him as to their disposal.

2. A case of Wild Dogs, lent for exhibition by Mr. T. Webber, whose address is unknown at present. Dr. Günther would propose to undertake the temporary custody of this case until it is claimed by the owner.

METEOR SHOWERS[1]

SEVERAL of the meteor streams observed at Bristol within the last two years appear to be of such marked intensity as to merit special description, and the following notes in connection with five of these may possess some interest to observers.

No.	Epoch.	Radiant. α °	Radiant. δ °	Date of Maximum.
I.	July 30–Aug. 1	32	+ 53	July 31, 1878.
II.	July 27–30	341	− 13	July 27, 28, 1878–9.
III.	August 21–25	291	+ 60	August 21–23, 1879.
IV.	October 14–20	31	+ 9	October 15, 1879.
V.	August 8–11	44	+ 25	August 8–11.

I. At the middle of July, 1877, a few meteors were traced from a radiant point at 36° + 47°, and on projecting a large number of meteor tracks registered in foreign catalogues for the period July 25–31, I found the same shower amply manifested from 25 paths, though the radiant was 5° higher in declination. A succession of clear nights occurred from July 26 to August 2 in 1878, and I obtained some lengthy observations. In about twenty-two hours of watching more than 400 shooting stars were seen in the eastern sky, chiefly amongst the constellations of Perseus, Cassiopeia, and Andromeda. I saw many swift meteors leaving short streaks and otherwise exhibiting much uniformity in their appearances and directions. The radiant point was not reconcilable with that of the well-known annual shower of Perseids. It was sharply defined about 3° S. of the group χ Persei, and the maximum of the shower was witnessed on July 31, when 21 meteors were noted diverging from the point described. In all I saw 63 meteors conforming to this stream; they were short and quick, always with streaks of 3° or 4° in the latter portion of their flights. I looked for the shower again in 1879, and

[1] Extract from a paper in the *Monthly Notices* of the Royal Astronomical Society, vol. xl., No. 3 (January, 1880).

recovered it both on July 28 and 29. It appears to be identical with a radiant given by Schmidt at 31° + 55°, August 3-12. The diagram shows the observed paths of 86 ↓s (in the region of the radiant point) recorded at Bristol in the years 1877-8, and includes some tracks in the catalogues of foreign observers.

II. Contemporary with these, χ Perseids, or Perseids II, my observations in July, 1878, led me to recognise a large number of slow meteors with long paths (averaging 17°) and occasionally leaving faint trails of sparks, ascending amongst the stars of Pegasus, Andromeda, &c., which, by their parallelism of motion, obviously proceeded from a common radiant point south of Pegasus. I watched them narrowly, and determined the position with fair precision as near δ Aquarii. The best display of this fine shower was on July 27, when 22 of its meteors were recorded, and in the ¾h. preceding midnight on July 30, eight of

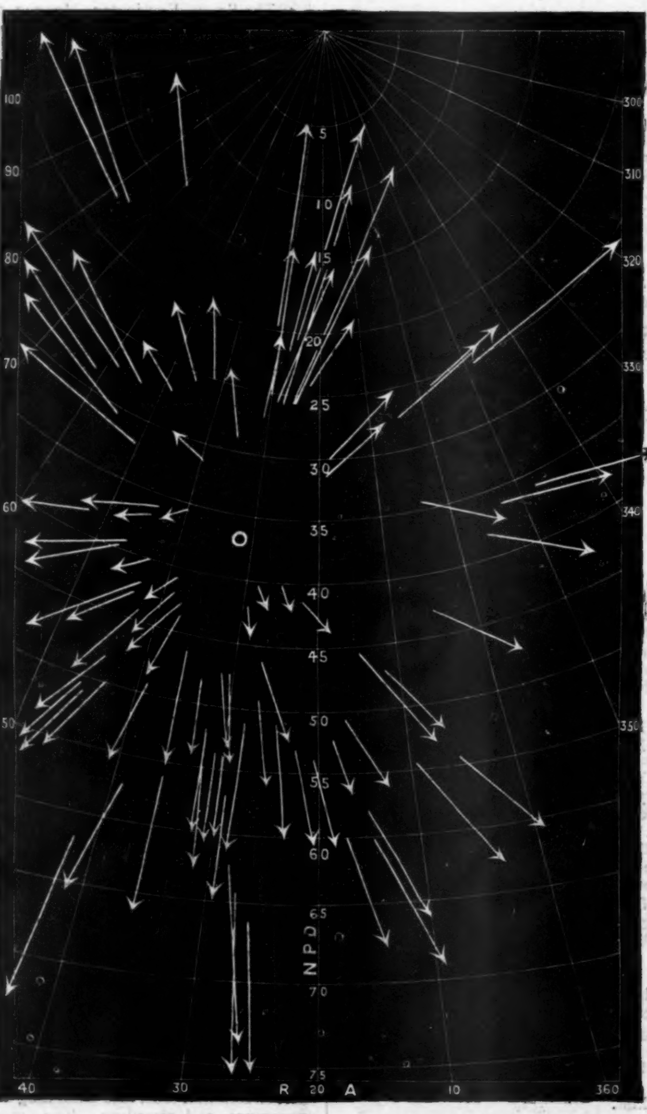

FIG. 1.—Shower of χ Perseids, or Perseids II, near the radiant point 32° + 53°, max. July 28—August 1.

these Aquariads were visible, though the radiant was close to the horizon; but on the following night the shower appeared to have become extinct. In 1879, July 28, it reappeared, giving very long gradual meteors similar to those seen the year before. The continuation of this radiant in August is rendered extremely probable by my observations in 1877, when I detected a good centre at 342° − 12° from 12 meteors, August 3-16, and by a bright stationary meteor, also recorded at Bristol, on August 9, 1879, at 342° − 16°. Major Tupman had obtained the best previous observations of this shower. On July 27, 1870, and several ensuing nights, he saw many meteors from an accurate radiant at 340° − 14°, and the position and epoch of the shower, as he determined it, agree perfectly with its apparition in 1878-79 recorded at Bristol. Prof. Herschel had also, as early as July 28, 1865, traced a few of its meteors. There are later showers (of very slow meteors) from the same region of Aquarius. The diagram

shows 41 tracks registered at the end of July, chiefly in 1878, at Bristol.

III. Beginning to observe at about 9h. 30m. on August 21, 1879, I immediately found a very active shower of slow, trained meteors proceeding from a point in Draco. I noted 9 of them in the ¾h. before 10h. 15m., though afterwards the display became less decided, and of the 68 meteors which I counted up to 13h. 30m. (when clouds overspread the sky) 21 belonged to this system. The two ensuing nights were clear, and I saw 143 shooting stars, including 31 additional paths conforming to the special shower in Draco, the exact position of which I determined at 291° + 60° (near *o* Draconis). The total number directed from this stream

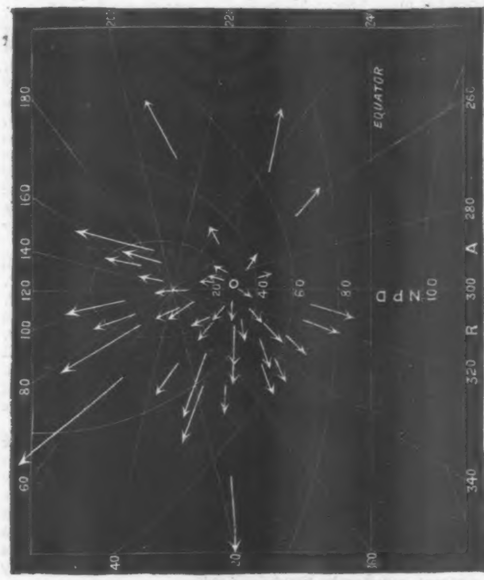

FIG. 3.—Shower of Draconids (291° + 60°), max. August 21–23.

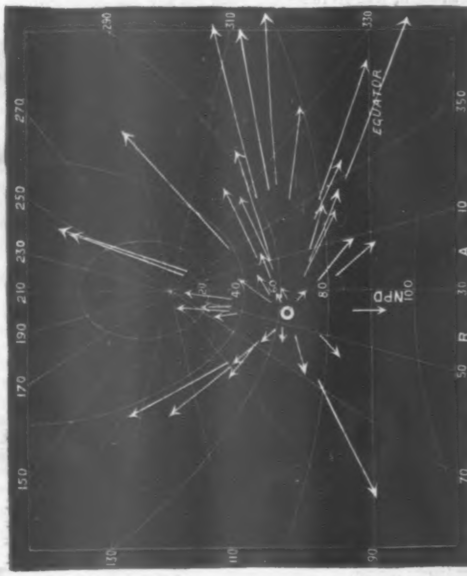

FIG. 5.—Shower of Muscids (44° + 25°), max. August 8–11.

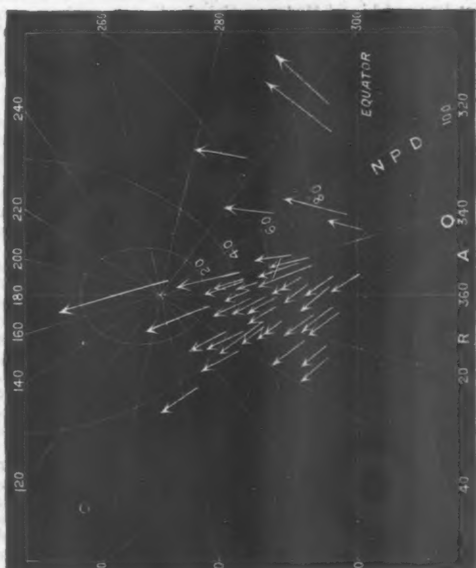

FIG. 2.—Shower of Aquarids (341° − 13°), max. July 27–30.

FIG. 4.—Shower of meteors from a radiant point at 31° + 9°, October 14–20 (max. October 15).

was 56 out of an aggregate of 225 meteors seen on August 21, 22, 23, and 25. The Draconids were generally brilliant, with short paths and spark-trails; motions rather slow. Ten exceeded or equalled the 1st mag. and 15 were estimated = 2nd mag. The shower is evidently identical with the Draconids II. (No. 78) of Greg's "Catalogue of Meteor Showers" (1876), in which the position is averaged at 282° + 60° and the whole duration extends from June 28 to August 25 (?) from 12 observations. There are other conspicuous showers directed from the same region in Draco at many other periods of the year. The diagram

gives 41 paths, nearly all of which were traced on August 21–23, 1879.

IV. On October 15, 1879, the sky was watched for eleven hours (6h. 30m. to 17h. 30m.), and of the 127 shooting-stars seen during that lengthy observation, 21 were slow meteors from a radiant point at 31° + 9°, but the position was not well defined. I had seen several meteors from the same region on the previous night, and on the 20th, when the sky was again favourable, I recorded 10 others, making 37 in all from this shower in the south of Aries. They were generally faint, with rather short paths, and decidedly slow. The same radiant was seen by Major Tupman in 1869, October 13, at 28° + 10°, and Mr. Corder has distinguished a series of October positions in Aries and Pisces. The diagram (IV.) includes 42 paths observed by me in the years 1876–79, but chiefly in 1879.

V. At about the middle of August, 1877, a few rapid meteors were traced from a radiant in Musca at 40° + 28°, and in the following year, while noting the progress of the Perseids, I recorded several fine meteors, leaving streaks, and with paths averaging 40°. The radiant was evidently on the horizon, and the directions of the meteors, which in several instances were very exactly observed and mapped, indicated the point 44° + 25° as the diverging focus of the shower. With the object of further investigating it, I examined the observations made at the epoch of the Perseids, by the Italians in 1872 and by Zezioli in 1867–70, and found many meteors conforming to this shower of Muscids, which had already been detected by Weiss in 1869, August 11, 46½° + 23½°, and August 12, 41½° + 24°. In this region, between Musca and the east extremity of Aries, there are many successive showers during the four months from August to November. Early in August, when the first display is perceptible, the meteors are very swift, with unusually long paths, and seldom without streaks; but in October and November the motions are generally slow, and the phosphorescent streaks, forming so persistent a feature of the earlier displays, have given way to occasional trains of ashy sparks. The August shower above referred to merits description, as supplying some fine long meteors in the mornings of August. Thirty-eight paths are shown in the diagram, several of which are notable on account of inordinate length.

The several showers here mentioned, being apparently of little less importance than the Orionids, Geminids, Taurids, &c., will no doubt be frequently seen in future years; and it seems desirable to select them from the mass of feeble systems now ascertained, as affording displays of more than ordinary richness.

W. F. DENNING

CHEMICAL SOCIETY—ANNIVERSARY MEETING

WE take the following extract from the address, at the Anniversary Meeting, of the Chemical Society on March 30, by the president, Dr. De la Rue:—

Although since my last term of office I have not been precisely in a sleepy hollow, like that described by Washington Irving, nevertheless my thoughts have been mainly absorbed by other branches of science, and I found myself, on returning to this chair, very much in the same perplexity as Rip Van Winkle when he awoke in the Kaatskill Mountains after his long sleep.

So rapid has been the progress of our science, that much of the aspect of chemical thought has altered in the interval; old and once familiar bodies have not only changed their nomenclature, but new and unfamiliar individuals and families have crowded into the greatly extended domain of chemistry. The very elements which are looked upon as most stable are now considered to be in a critical position, and liable at any moment to dissociation; for it is only a few months ago that the minds of chemists were disturbed by the announcement that spectroscopic evidence afforded by the sun and stars tended to show that the so-called elements were in reality compound bodies. Even if we reserve our judgment on this point, we can no longer assert that the light emitted from the so-called elements, when incandescent or vaporised, is characterised by certain definite wavelengths. Moreover, we learn that a well-known German chemist, Professor V. Meyer, has actually succeeded in dissociating the halogens, chlorine, bromine, and iodine. The results which he and his coadjutors have obtained appear to leave little doubt that such is actually the case, and we must await the outcome of their continued labours with intense interest.

As regards the spectrum itself, we can no longer attribute certain specific functions and properties to different parts of it; for Captain Abney has shown that every part of the spectrum acts actinically, and he even goes so far as to hold out a prospect of Becquerel's beautiful discovery being further extended, so as to produce permanent photographs of the spectrum in its natural colours. In his Bakerian lecture to the Royal Society, Captain Abney has made known his method of preparing a form of silver bromide, sensitive not only to the ultra-violet and the whole visible spectrum, but also to the infra-red rays, and has presented to that Society his magnificent map of the infra-red spectrum. It is difficult to overrate the value of this discovery, and it may be expected that important results will accrue from the investigation of the infra-red absorption spectra of various substances. Indeed, Captain Abney has already informed me of his progress in this direction. The importance of photography, not only as affording a means of investigation, but as a method of permanently recording observations which may be dealt with at leisure, thus affording the means of accurate measurement, in such hands as those of Dewar, Liveing, and Abney, cannot be too highly prized.

A problem which had long baffled all efforts, the artificial production of the diamond, is said to have been solved. Mr. Hannay's communication on the subject is so vague, however, that it is impossible to pronounce any opinion on it. The observations on the solubility of solids in gases, which led Mr. Hannay to attempt to crystallise carbon, and which are described in a recent communication to the Royal Society by Messrs. Hannay and Hogarth, are of great interest, and most important results will doubtless be obtained by an extension of these experiments.

The necessity for further information on the subject of the behaviour of various substances, and especially of mixtures under great pressure, is well shown by the recent remarkable observations of Cailletet, that on compressing a mixture of five volumes of carbon dioxide and one volume of air, the former at first liquefies; but that as the pressure is increased to 150–200 atmospheres, the meniscus of the liquid carbon dioxide becomes plane, and is gradually effaced, until finally the liquid wholly disappears, apparently dissolving in the gas.

Mr. Ansdell's papers on the "Physical Constants of Liquid Acetylene and Liquid Hydrogen Chloride," as determined with the aid of the Cailletet apparatus in the laboratory of the Royal Institution, are valuable contributions to our knowledge of chemical physics, and appear to furnish the interesting result, that the volume of the fluid and gas are equal at the critical point in the case of the latter substance.

Another investigation in chemical physics of great interest is that recently published by Brühl, who has considerably extended the observations of Gladstone, Landolt, and others, on the refractive indices of carbon-compounds. The introduction of a new method of calculating the results by which the influence of dispersion is eliminated, has led him to the discovery of an apparently very simple relation between chemical constitution and refractive power.

The extraordinary diligence of chemists who apply themselves to the investigation of carbon-compounds has also reaped a rich harvest of results. It would be impossible for me to consider the progress of this branch of chemistry in detail, but I cannot help noticing how rapidly the more complex bodies, such as the alkaloïds and the carbo-hydrates, are being forced to yield up the secret of their constitution, which has so long been withheld. The synthesis of *Isatin* by Claisen and Shadwell, and the researches of Baeyer in the indigo-group, must, it would seem, ere long result in the discovery of a method for the artificial manufacture of this colouring matter.

Ladenburg's success in preparing the alkaloïd atropine from *Tropine* and *Tropic* acid, the two substances which it furnishes when decomposed by hydration, is no doubt the first step towards the synthesis of an alkaloïd. Great advances have been made in unravelling the constitution of the bases of the Pyridine and Picoline series, and much light has been thrown thereby on the constitution of nicotine and the Cinchona alkaloïds. Moreover, important additions have been made to our knowledge of starch. It is remarkable, also, that a number of new facts have been brought to light tending to prove that the symbolic system at present employed to represent the constitution of carbon-compounds is insufficient.

The year has not passed by without announcements of new members of the family of Elements. One of the most inter-

esting and best authenticated is that of Scandium, which has been separated from Norwegian Gadolinite and Yttrotitanite by Nelson and Clive. I had the advantage, when last year in the University of Upsala, of being shown the spectrum of this metal by Professor Thalén, and of making the personal acquaintance of its distinguished discoverers, who showed me the enormous amount of material they worked upon in order to obtain the specimen I saw. Scandium, according to Clive, has the atomic weight 45, and the properties of its compounds are almost exactly those predicted by Mendelejeff of the hypothetical element *Ekaboron*, to which the atomic weight 44 was assigned. We have thus apparently, for the second time, a remarkable verification of Mendelejeff's sagacity and the importance of his so-called Periodic Law. I may here refer to the service Mr. Crookes has rendered by publishing a translation of a revise of Mendelejeff's celebrated paper in *Liebig's Annalen*.

The Report of the Research Fund will be found in the Appendix, and it is not necessary for me to enter upon its details. There is much work always to be done of the highest importance to the advancement of chemistry, but which does not offer sufficient attraction to induce the devotion of the time, perseverance, and money necessary for its accomplishment; here the Research Fund steps in and removes one of the obstacles. In other cases, where the necessary zeal and talent exist to commence a valuable research, the chemist may not be in a position to devote time and money for the undertaking; but with funds at its disposal our Society can prevent the opportunity from being lost. I trust that those whose position of fortune permits of their doing it will contribute largely to the Research Fund, and thus promote the advancement of a science which may have contributed greatly to their own prosperity.

The Drapers' Company for the last three years contributed 105*l*. per annum to the Research Fund, and the Goldsmiths' Company at the commencement gave a munificent donation of 1,000*l*.; the City Companies cannot devote a portion of their vast revenues more usefully than in promoting scientific researches, for with the advance of knowledge will the prosperity of our country develop. The past year has been one of peaceful prosperity in our Society, and we have had a large accession to our members, and the alteration of the bye-law relating to the election of candidates has, on the whole, worked well; but as it has been frequently necessary to postpone the ballot for want of sufficient attendance, it has therefore been thought desirable to make a change in it.

APPENDIX.

Third Report of the Research Fund Committee.—During the past session the following sums have been granted from the Research Fund by the Council on the recommendation of the Research Fund Committee:—

30*l*. to Mr. M. Whitley Williams, for the elaboration of an improved method of Organic Analysis.

25*l*. to Mr. M. M. P. Muir, for the study of the Chemical Habitudes and Physical Constants of Bismuth Compounds.

15*l*. to Mr. J. M. Thomson, for experiments on the action of Isomorphous Bodies in exciting the Crystalisation of Supersaturated Solutions.

50*l*. to Dr. Wright, for the continuation of his investigations of certain points in Chemical Dynamics.

25*l*. to Mr. F. D. Brown, for the continuation of his investigation of the theory of Fractional Distillation.

30*l*. to Mr. Bolas, for the preparation and investigation of Alloys and Compounds of Chromium.

20*l*. to Dr. Japp, for the investigation of the action of the Organo-zinc Compounds on Quinones.

100*l*. to Dr. Armstrong, for the determination of certain physical properties, especially the Refractive Indices of Typical Chemical Compounds.

100*l*. to Dr. Wright, for the determination of Chemical Affinity in terms of Electrical Magnitudes.

100*l*. to Mr. F. D. Brown, for the determination of the Vapour Tension of Pure Compounds and of Mixtures.

The two last-mentioned grants were made in February of this year, the others in June, 1879.

A donation of 105*l*. from the Worshipful Company of Drapers, and one of 100*l*. for which the Society is indebted to the generosity of its president, Mr. De la Rue, are important items in the income of the fund for the year. The Committee desire to point out to the Council and to the Fellows at large the desirability of obtaining further additions to the fund, for without such contributions as these the income arising from investments would have been quite inadequate to meet the legitimate demands upon the fund. It is to be expected, and indeed we hope, that these demands will increase rather than diminish, and it is therefore especially necessary that efforts should be made to increase the income of the fund.

During the session the result of several investigations, in aid of which grants have been made from the Research Fund, have been communicated to the Society.

Dr. Tilden, in a paper on terpene and terpinol (*Trans.*, 1879, 286–290), after describing several properties of these bodies, adduces evidence to prove that the latter is a constituent of some essential oils, as oil of lemon and cajuput.

Prof. Thorp has described (*Trans.*, 1879, 296–309) the results of his examination of so-called abietene, the exudation from the Californian nut or Digger pine (*Pinus sabiniana*). He finds it to consist of the almost pure paraffin, normal heptane, C_7H_{16}, and having thus obtained a considerable quantity of this hydrocarbon, he has availed himself of the opportunity to make a series of most valuable determinations of several of its physical constants.

Dr. Wright, in conjunction with Messrs. Luff and Rennie (*Trans.* 1879, 475–524), has presented a voluminous third report on his researches on some points of chemical dynamics, describing at length the result of experiments on the relation between the rate of the reduction of cupric oxide by hydrogen or carbon monoxides, time, and temperature.

Mr. F. D. Brown has described the behaviour of mixtures of benzene and carbon bisulphide when distilled under various conditions as a contribution to the theory of fractional distillation (*Trans.*, 1879, 547–562). In a second communication (*Trans.*, 1880, 49–60) he has embodied the results of the comparison of the value of the different methods of fractional distillation.

Drs. Armstrong and Tilden have presented an account (*Trans.*, 1879, 733–760) of their examination of the action of sulphuric acid under various conditions on the terpenes. One of the chief results of their investigation is to establish the fact that no such substance as terebene exists, the liquid hitherto described under this name being simply impure camphene.

Dr. Bedson (*Trans.*, 1880, 90–102) has carefully examined a number of derivatives of phenylacetic acid, an acid which has now become of special interest to the chemist on account of its relation to indigo.

The investigation of Messrs. Hartley and Huntington on the action of organic compounds in absorbing the ultra-violet rays of the spectrum referred to in the last report has since been published in the *Transactions* of the Royal Society. These gentlemen also have since submitted to the Royal Society an account of the results of the combination of the investigations.

Dr. Tilden has communicated the chief results of experiments on the action of hydrochloric acid upon terpenes—a portion of the subject for which he received a grant from the Society—to the Chemical Society of Berlin (*Ber.*, 12, 1131).

The experiments on the action of iodine on terpenes and on the saturated hydrocarbon, referred to by Dr. Armstrong in the last report, have been partially described in communications to the Berlin Chemical Society (*Ber.*, 12, 1756–1790). The publication of the observations on camphor has been delayed in order to render them as complete as possible.

Dr. Japp has forwarded to the Secretaries a paper which will be read at the next meeting, in which he describes the results of his investigations of the action of zinc ethyl on phenanthraquinone.

Several gentlemen who have received grants, but not yet communicated their results to the Society, viz., Messrs. Bolas, Burghardt, Dupré, Jago, Shenstone, and Williams, have favoured the Committee with preliminary reports of the progress made in their investigations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—A little more than one half of the total cost of the new hall of Newnham College has now been received or paid, and the amalgamation of Newnham Hall with the Lecture Association may be described as almost completed. To pay for the buildings and furnish them about 5,000*l*. more will be needed. The laboratory and gymnasium are excellent.

Messrs. Shaw (Emmanuel College) and Glazebrook (Trinity

College) have been appointed Demonstrators in the Cavendish Laboratory of Experimental Physics.

The University Commissioners have at last put forward a Statute by which students in "Letters" are to have a Doctorate, so that to Divinity, Law, and Medicine, two new faculties are now added, namely, Letters and Science. The University is also to have power to accept as an affiliated college any college in the British dominions, educating principally adult students, and to allow their qualified students three terms of residence towards those required to obtain a Cambridge degree.

The Woodwardian Professor gives notice that as he is prevented by illness from returning to Cambridge at present, Mr. Roberts, D.Sc. [Lond], will lecture for him during the present term.

THE returns already received for the Technological Examinations of the City and Guilds Institute show that over 1,100 candidates will present themselves for examination at eighty centres. This is a very large increase on last year, when only 202 were examined. The examinations are to be held on the evening of May 12, concurrently with the examination of the Science and Art Department on that evening.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science*, April.—W. T. Thiselton Dyer, M.A., Assistant-Director, Kew, on the coffee-leaf disease of Ceylon (six plates).—J. D. Siddall, on Shepheardella, an undescribed type of marine rhizopoda (on the plates Shepheardia), with two plates. The nucleus in this form seems to be unlike anything as yet described among the rhizopods. The author also figures and describes *Lieberkuehnia wageneri* from Tenby. This rhizopod is only "a native of Berlin" in a very peculiar sense. Claparède's words are, "Nous n'avons rencontré qu'une seule fois ce rhizopode, à Berlin dans une petite bouteille qui renfermait de l'eau de provenance inconnue." The present memoir throws no new light on its probable affinity to *Pamphagus mutabilis*.—A. Sedgwick, on the development of the kidney in its relation to the wolffian body in the chick (with two plates).—F. M. Balfour, notes on the development of the Araneina (with three plates).—Dr. L. Waldstein, a contribution to the biology of bacteria.—Prof. Schäfer, some teachings of development.—Prof. T. Jeffery Parker, on the histology of *Hydra fusca*.—Prof. Giard, on the Orthonectida, a new class of the phylum of the worms (with a plate).—Notes and memoranda.

American Journal of Science, March.—On a chart of the magnetic declination in the United States, constructed by J. E. Hilgard.—The old river-beds of California, by J. Le Conte.—Age of the Green Mountains, by J. D. Dana.—On a new action of the magnet on electric currents, by E. H. Hall.—Measures of the polar and equatorial diameter of Mars, made at Princeton, New Jersey, U.S., by C. A. Young.—On the use of the sine-formula for the diurnal variation of temperature, by B. A. Gould.—On the chemical composition of the Uraninite from Branchville, Conn., by W. J. Comstock.—On the mean free path of a molecule, by N. D. C. Hodges.—On the western limits of the Taconic system, by S. W. Ford.—Principal characters of American Jurassic dinosaurs, by O. C. Marsh. Part iii.

THE *American Entomologist*, No. 3, new series, March, 1880, contains a multitude of useful notes on questions concerning entomology, amongst which may be noticed trapping the Carpet Beetle (*Anthrenus scrophulariæ*).—The Ailanthus silkworm.—Insects injuring the black locust.—The insect enemies of our small fruits, by A. S. Fuller.—The relation between insects and plants, and the consensus in animal and vegetable life, by L. F. Ward.—Birds *v.* insects, by the late E. Perris, translated.—Two days collecting in the Mammoth Cave, with contributions to a study of its fauna, by H. G. Hubbard, the latter especially interesting, giving a list of all the animals hitherto found in this celebrated cave, highly illustrated by excellent woodcuts, with a description of a very curious new form of pseudo-scorpion, described by Dr. Hagen as *Chthonius packardi*. It will be a great advantage if the editors of this periodical give in future a *résumé* of the contents of each number. We are requested to notice that it is now published by the Hub Publishing Company of New York, 323 Pearl Street.

Journal of the Franklin Institute, March.—The Edison electric light (continued), by Mr. Outerbridge.—Committee's report on the Goodwin mowing-machine.—Saws (continued), by Dr. Grimshaw.—Apparatus for illustrating the aberration of light, by Prof. Tobin.—On the acid products of combustion of coal, by M. Vincotte (translation).—Mica, by Mr. Rand.—A new lecture experiment; the cupelling of gold and silver.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 8.—"On the Sensitive State of Vacuum Discharges. Part II." By William Spottiswoode, D.C.L., LL.D., Pres.R.S., and J. Fletcher Moulton, late Fellow of Christ's College, Cambridge.

This paper forms a sequel to that published under the same title in the *Phil. Trans.*, 1879. It describes a continuation of the research into the nature and laws of the disruptive discharge, or electric spark. The methods of the earlier paper have been extended, and others adapted to the new circumstances have been devised, in order to carry the investigation into high vacua. In particular, independent sources of electricity have been used for effecting the discharge, whether in the sensitive or in the non-sensitive state; and the results have been confirmatory of the conclusions derived from the more limited means formerly described. Further, the effects of various tubes containing discharges in the sensitive state upon a tube containing a discharge in the non-sensitive state have been observed and compared; and the tube so used as a test has been called the standard tube, and the method of its use the standard tube method. By this means, principally, the laws of the discharge in comparatively moderate vacua have been extended to high vacua.

In the higher vacua, the phenomena of molecular streams, and the phosphorescence consequent on them, that have been studied and described by Mr. Crookes, present themselves. These derive great importance for the purposes of the present paper from the fact that in high vacua the ordinary luminous discharge becomes so feeble in appearance that it is often difficult to observe. Under these circumstances the phosphorescence, which, like the ordinary luminous effects, may exist either in a sensitive or in a non-sensitive state, forms the best index of what is going on within the tube. Much information as to the nature and procedure of the discharge may be derived from the mode of interference of one molecular stream with another, from the direction and character of shadows cast by these streams, and by a form of interference which has here been called that of virtual shadows.

The conditions of pressure and of electrical violence, under which phosphorescence is produced, have been carefully studied; and it has been found that, with a suitable adjustment of the discharge, the phenomena are not confined to high vacua, but can be obtained under pressures much exceeding those of ordinary vacuum tubes. The phenomena of these molecular streams have also been compared with those exhibited by the projection of finely divided solid conducting matter when heaped up over the negative terminal, with the view of ascertaining the nature of the phenomenon and its position in the discharge.

At the close of the paper the authors have discussed some of the general conclusions which they think may be fairly drawn from their present researches. First, as to the relative order of magnitude of the time-quantities entering into the discharge; *e.g.*, the times occupied by the discharge of positive or negative electricity, or of molecular streams, in leaving a terminal; the time occupied by the same elements in passing along the tube, &c. Secondly, as to the durational character of the negative as compared with the positive discharge, which appears to increase with the degree of exhaustion. Thirdly, as to the mode of formation of the positive column; and fourthly, as to the relation of the molecular streams to the discharge proper.

But for the details of these conclusions the reader must be referred to the paper itself.

April 15.—"Description of some Remains of the Gigantic Land-lizard (*Megalania prisca*, Owen) from Australia. Part II.," by Prof. Owen, C.B., F.R.S.—Referring to a former Part (*Phil. Trans.* 1858, p. 43), the author gives, in the present, descriptions of subsequently received fossils of *Megalania prisca*, advancing the knowledge of that species of large extinct lizard. Characters of the dorsal, sacral, and caudal vertebræ, with those of a considerable portion of the skull, are detailed. So much of the upper jaw as is preserved shows the species to have had that part sheathed with horn as in the tortoise. Upon the head were

seven horns, three in pairs, and one single; they are defined as the "supraparietal," "supratemporal," and "post-orbital" pairs; the single and symmetrical horn is "nasal."

In the comparison of this character with the known genera of lizards the author finds the closest correspondence in the diminutive existing Australian species, *Moloch horridus*, Gray. He concludes with remarks on the probable habits and conditions of extinction of the subject of his two papers.

"Report on the Exploration of the Caves of Borneo," by A. Hart Everett. "Introductory Remarks," by John Evans, D.C.L., LL.D., Treas. R.S. And "Note on the Bones Collected," by G. Busk, V.P.R.S.

The general result of the exploration may be summed up as follows:—The existence of ossiferous caves in Borneo has been proved, and at the same time the existence of man in the island with the fauna, whose remains are entombed in these caves. But, both from the recent nature of this fauna, and from the fact that the race of men whose remains are associated with it had already reached an advanced stage of civilisation, the discovery has in no way aided the solution of those problems for the unravelling of which it was originally promoted. No light has been thrown on the origin of the human race—the history of the development of the fauna characterising the Indo-Malayan subregion has not been advanced—nor, virtually, has any evidence been obtained towards showing what races of men inhabited Borneo previously to the immigration of the various tribes of Malayan stock which now people the island. Furthermore, the presumption that the north-west portion of Borneo has too recently emerged above the waters of the sea to render it probable that future discoveries will be made of cave deposits of greatly higher antiquity than those already examined, has been strengthened. Under these circumstances it seems advisable that cavern-research in north-west Borneo should now be left to private enterprise, and that no further expense should be hazarded, at any rate until the higher parts of the island in the north-east may be conveniently examined.

"Note on the Collection of Bones from Caves in Borneo, referred to in Mr. Everett's Report on the 'Exploration of the Bornean Caves in 1878-9,'" by George Busk, F.R.S., V.P. Anth. Inst.

These bones present nothing of especial interest; and with respect to the race to which they may have belonged, the information they have afforded is very meagre. On this point all that can be said is that they may well have belonged to the Malay type, but there is also no apparent reason why they should not have been of Chinese origin. What tends to afford some support to this supposition is the marked fulness or bulging of the squamosal in the sphenoidal fossa, to which I have called attention, and which, upon examination of the collection of crania in the Royal College of Surgeons, I find is presented by several among the Chinese crania in a more marked degree than in the other races to which my attention was directed.

Physical Society, April 10.—Prof. Fuller in the chair.—New members:—Mr. W. O. Smith, Prof. Judd, F.R.S.—A paper on the human eye as an automatic photometer, by Mr. William Ackroyd, was read. It is difficult to get the value of a very intense light in terms of a weak one, because the relative physiological values of the similarly coloured constituents are unknown. The author's experiments were made to show that the eye itself is a fairly good light measurer. When a "spot" or star of light is looked at from a distance, it is seen to emit "rays" or spokes of light at all angles. These are due to the radiate structure of the crystalline lens and to the lachrymal fluid on the surface of the corner of the eye. The rays are of various lengths and are shorter in the 1st and 2nd quadrants, next the nose, near the blind spots, than on the 3rd and 4th quadrants—a fact probably due to the insensibility of this region. The iris expands and contracts under the stimulus of light independently of the will; and both irises act sympathetically. Now the iris lies between the seats of irregular refraction, and thus any change in the size of the pupillary aperture will be rendered evident by an alteration in the length of the longer rays of a spot or point of light. On this fact is based the use of the eye as an automatic photometer. The sensitiveness of the iris varies in different persons. The author finds that a sperm candle, burning 120 grains per hour, produces a distinct movement of his iris when 14 yards distant. In employing the eye as a photometer, the author adopts the principle that if the light from one source A falling on the eye is capable of producing movement of the iris at a distance d, and the light from a different source B is capable of producing the same movement at the distance d', then the relative intensity is proportional to the squares of these distances. To carry this out in practice the observer is in the dark, and an artificial star is placed on a level with the eyes at a fixed distance. Below this is placed the light to be tested in the same plane. While gazing steadily at the star the other light is to be eclipsed and revealed, and the observer is to find a position where the revealing of the second light does not influence his iris, as shown by no apparent shortening of the rays of the star taking place. He then approaches gradually till a second position is reached, when the revealing of the second light *does* produce a movement of the iris. The distance between his eye and the light, d, is measured. A third light is now put in place of the second, and the same observations repeated, so as to get a second distance, d'. From these distances the relative intensities are calculated; the author's results agree pretty closely with Rumford's photometer, but he found that for some reason the two first observations have to be discarded as too inaccurate. Owing to the sympathy between the two irises these experiments were binocular. This sympathy may prove convenient in constructing an eye-photometer, since one eye can be turned to the light to be estimated while the other is looking at the artificial star. This method of photometry would be too delicate for comparing powerful electric lights, unless aided by mechanical means.—Prof. Ayrton then offered an explanation of the experiment shown by Prof. Guthrie at last meeting to the effect that while flannel rubbed with ebonite was + electrified, and ebonite rubbed with glass was +, flannel rubbed with glass was −. Prof. Ayrton accounted for this apparent anomaly on the ground that one or more of the substances was an electrolyte. Glass, for instance, is an electrolyte, and a battery had been made from it. Experiments made by Prof. Perry and himself had shown that in a "pile" made up of divers substances, one or more of which were electrolytes, though the rest were metals, the electromotive force of the pile was equivalent to the algebraical sum of the several "pairs" composing it, but it was *not* equivalent to the electromotive force of the first and final plates made into a pair. That could not be predicated from the contact-electromotive forces of the elementary "pairs." When only metals were employed it could, but not in cases where an electrolyte entered. This same result would apply to Prof. Guthrie's frictional experiments. In answer to Prof. Guthrie's question whether electrolysis did not come into play in Prof. Ayrton's experiments, Prof. Ayrton replied that it could not operate to a greater extent than in Prof. Guthrie's experiments, as he had used a quadrant electrometer.—Dr. Stone then described a new tonometer devised by Prof. Rudolf König, which he had recently seen in Paris. It consisted of a clock-work working into a tuning-fork, which produced no less than 128 escapes per second. To this clock-work, originally invented by an assistant of M. Breguet, and exhibited at the Paris Exhibition of 1856, Prof. König had added a Helmholtz vibration microscope moved by the clock and the fork, whose vibration number to be measured is placed vertically in the focus of the microscope. The tonometer is very portable, and no loading of the fork is required. Prof. Hughes observed that he had patented a vibrating regulator in 1856.—Dr. Guthrie then exhibited an electric machine formed of a collodion disk rubbed with a cat's fur, and giving negative sparks. The collodion, after a suggestion of Capt. Abney, was put on by giving a disk a coat of collodion, then a coat of india-rubber dissolved in benzol, then a coat of collodion again. Prof. Guthrie also showed that an iron cylinder revolving round its longer axis, and with a current flowing in a wire parallel to it, has power to deflect a magnetic needle. Prof. Ayrton stated that he had found the mere rotation of an iron cylinder produced the deflection in question, and therefore thought the current was not required to produce the effect shown.

PHILADELPHIA

Academy of Natural Sciences, November 11, 1879.—On a collection of crustacea from Virginia, North Carolina, and Florida, with a revision of the genera of Cragonidæ and Palæmonidæ, by J. S. Kingsley.

November 18.—On the stratigraphical evidence afforded by the Tertiary fossils of the Peninsula of Maryland, by Angelo Heilprin.

December 9.—Description of a fœtal walrus, by Dr. Harrison Allen.—Complete connection of the *Fissura centralis* (fissure of Rolando) with *Fossa sylvii*, by Dr. A. J. Parker.

December 30.—Annual meeting.—Dr. Ruschenberger, the president, gave a *résumé* of the Society's work, describing it not as an exclusive but as an inclusive Society for the acquirement, increase, simplification, and diffusion of natural knowledge. Its members have signalised themselves by doing their own printing in the Academy Hall; in fact gratuitous labour produces all the matter published by the Academy. The institution is free from debt, with a substantial building, and large collections of objects as yet little studied. During last year the card catalogue of works on anatomy and physiology has been completed, and the only departments of the library not yet possessing a special catalogue will be those of anthropology and mineralogy; these it is hoped to complete this year. In the museum work Mr. J. A. Ryder has now identified 700 species of fishes in 325 genera. The museum has had a notable acquisition in the archæological collections of the American Philosophical Society, especially consisting of the Poinsett collection of Mexican antiquities, and many Peruvian remains; while Mr. W. S. Vaux has borne the expense of adapting a room to receive the collection. The skeleton of a native of the Chatham Islands has been presented by Mr. W. H. Rau. Many fossils of great interest and value, including bones of Uintatherium, Palæosyopæ, and Crocodile, from Green River, Wyoming, have also been added. The Section of Biology and Microscopy has had two special *soirées* and seventeen meetings. In Conchology 2,750 trays, containing 11,895 specimens, have been determined, labelled, mounted, and placed in the collection. The arrangement of the Swift Collection is now completed, after three years' labour; it is especially rich in West Indian shells, and especially in terrestrial species; it comprises 7,058 trays, containing 30,384 specimens. Mr. C. F. Parker has been a very active worker in this department, and Mr. John Ford, vice-director of the section, has prepared sections of many shells to show their internal form. Donations have been very numerous and valuable. The Herbarium has received very valuable donations, and the gaps in the genera are now mostly from rare districts. Dr. Asa Gray has during the year revised many perplexing genera in the North American Compositæ, and Mr. Parker is mounting the plants, with Dr. Gray's notes affixed, as fast as elaborated. There is great and valuable voluntary work going on by many botanical workers; 2,181 species have been received during the year, especially 623 species of Florida plants, including many new and rare species collected and presented by Dr. A. P. Garber, and many hundreds of foreign plants, by Dr. Asa Gray.

PARIS

Academy of Sciences, April 19.—M. Edm. Becquerel in the chair.—The following papers were read:—On the inverse problem of motion of a material point on a surface of revolution, by M. Resal.—On the reciprocal displacements of the halogen elements, by M. Berthelot.—On the stability of oxygenated water, by M. Berthelot. The spontaneous decomposition of this compound becomes slower and slower in course of time. The rate of transformation varies remarkably with the presence of foreign substances in the liquor. The least trace of a base or free alkali causes rapid decomposition; acids retard the process; variation in amount of acid hardly affects it, but the special nature of the acid does. Temperature accelerates the process.—On the earths of samarskite, by M. Marignac. He confines himself here to those earths the nitrates of which are last decomposed. To separate these he had recourse to their difference of solubility in a saturated solution of sulphate of potash. He finds, then, yttria (the principal element), terbine, a new earth Y_a, and a small quantity of oxide of didymium, and of an earth, which, if not pure decipium, is at least in great part composed of it.—On the interoceanic canal of Panama, by M. de Lesseps. No serious difficulty is anticipated. The length of the canal will be 73 km., while the Suez Canal is 162. From the Atlantic the entrance will be by the mouth of the River Chagres (which will be deepened), and at Cruces, where this river issues from the mountains, a dam of 46m. height will be raised, making possible the storage of 1 milliard cubic metres of water. Beyond Cruces the canal traverses the mountain of Culebra by a cutting of 5km., and then the bed of the Rio Grande is utilised to the Bay of Panama.—Observations on Megapoda, by M. Oustalet. He gives results of a visit to the English and Dutch museums; thinks the number of species allowed by ornithologists too large and reducible to about twenty-five; proposes a new subdivision of the genus *Talegallus*, the sub-genus *Æpypodius*, including the *T.* of Waigiou (which he calls *T. Bruijnii*), and *T. pyrrhopygius*; he also seeks to rectify the frontiers assigned to Peristeropoda by Huxley.—Theory of capillary phenomena (5th memoir), by M. Roger.—On the electromagnetic gyroscope, by M. de Fonvielle. The impossibility of getting rotation with induction-coils whose induced wire was very long, and in which therefore the difference referred to by M. Jamin was as great as possible, led him to reject M. Jamin's explanation.—Discovery of a comet by M. Schaberle (telegram from the Smithsonian Institution), communicated by Admiral Mouchez.—Observations of the same comet at Paris Observatory, by MM. Henry and Bigourdan.—On the positions of the principal planets, by Mr. Chase.—Remarks on the formulæ of quadrature of Gauss, by M. Radau.—Electric synchronism of any two motions, by M. Deprez. He transmits electrically the movement of a motor A to a receiver B, so that the angular velocity of B is always equal in amount and sign to that of A. The transmitter has two commutators for inversion of current, and the receiver two straight electromagnets which rotate between the branches of a fixed one.—Measurement of thermo-electric electromotive forces in contact of a metal and a liquid, by M. Bouty. A derivation from a circuit of known resistance, traversed by the current of one Daniell element, comprised (1) a thermoelectric apparatus, formed of two tubes containing a liquid kept at different temperatures, and two metallic plates of the same metal, the tubes being connected by a long capillary syphon; (2) a sensitive Lippmann electrometer. The results with various metals and salts of these in water-solution, where the warm metal is exteriorly the positive pole, are tabulated. The thermo-electric force is rigorously proportional to the difference of temperature of the plates, and does not sensibly vary with the degree of dilution of the salt. Salts of a given oxide give nearly the same number, and the number for copper and amalgamated zinc are nearly identical. Where the cold metal is exteriorly the positive pole, the measurements become uncertain, and the variations of electromotive force are no longer proportional to the temperature.—On an automatic mercury pump, by M. Couttolene. This is for increasing a vacuum commenced by a water-trompe.—On tropeins, artificial mydriatic alkaloids, by M. Ladenburg.—On gelose, by M. Morin.—On carbonate of ammonia, by M. Maumerle. Two samples, nearly identical, showed very different properties.—On existence of ammonia in plants and muscular flesh, by M. Pellet. *Inter alia*, the strong ammoniacal odour perceived in sugar manufacture, when the juice is treated with lime, is accounted for by the ammonia found in beet. Plants containing much of alkaline phosphates (*e.g.*, corn) have their carbonates decomposed by these. In flesh of ox M. Pellet found 0·15 gr. ammonia per cent. of the substance.—On an adulteration of silicate of soda, by M. Jean. Anhydrous soap was the substance added.—On the variability of the teats of Ovides of the Lower Cevennes, by M. Tayon.—On treatment of Arabian elephantiasis by simultaneous use of continuous and intermittent currents, by MM. Moncorvo and Aranjo. The continuous currents soften the tissues, and the intermittent promote reabsorption.

CONTENTS

1880

o Peri-
na (5th
ope, by
on with
n which
great as
scovery
hsonian
rvations
Bigour-
hase.—
Radau.
ez. He
eiver B,
unt and
tors for
magnets
urement
etal and
known
lement,
o tubes
nd two
ected by
ometer,
water-
ve pole,
propor-
does not
lts of a
nber for
here the
rements
orce are
tomatic
easing a
as, arti-
gelose,
umerle.
operties.
by M.
eived in
e, is ac-
ntaining
rbonates
0·15 gr.
ation of
he sub-
s of the
Arabian
rmittent
ntinuous
note re-